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Contents.

	PAGE
Steel and Cast Iron—What are They?	153
On the Definitions of Steel and Cast Iron	154
A Power-driven Core-making Machine	155
Association of German Iron Foundries	156
Dilatometric Investigation of Cast Iron	156
Skin-Dried Moulds	157
An Addendum to "The Practice and Purpose of Perlit Iron"	159
Properties of Unusual Alloy Steels	162
Pattern Plates	163
Iron Impurity in Cast Red Brass	166
Charcoal as Cupola Fuel	166
Ermack Spot-Welding Machine	167
Obituary	168
Trade Talk	168
Contracts Open	168
Patent Specifications Accepted	168
Iron and Steel Markets	170

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Steel and Cast Iron—What are They?

Elsewhere in this issue there is an article by Prof. Honda on the definitions of steel and cast iron. He has defined steel as "an iron-carbon alloy with a carbon content lying between 0.035 and 1.7 per cent.," and adds a rider that "wrought iron may be a steel lowest in carbon." Dealing with wrought iron first we think he might, without unduly complicating matters, add, "and containing free slag."

We agree that Prof. Honda's definition is most reasonable, but surely it should be qualified by the word *ordinary*, as obviously high-speed steel, nickel chrome, stainless, magnet, high-nickel and a host of other special steels are not "iron-carbon alloys," but are alloys of a tertiary, quaternary and of an even further complex nature. Granting that Prof. Honda meant to confine himself to "ordinary plain-carbon steel," there is still one alloy which is not covered by his definition, and must consequently be classed as cast iron. This steel is used for wire drawing, and often contains 2 per cent. of carbon, yet it is reduced slightly by forging and is punched to gauge. We admit that the majority of these wortle plates are now made of "special," that is, alloy steel. Inherently one feels this material is steel, and would be covered by the older, yet more indefinite definitions, all of which are tainted with an over abundance of relativity. Yet plain wortle plates would be classified as cast iron according to Prof. Honda, whose definition of this material reads:—"Cast iron is an iron-carbon alloy with the content of carbon lying between 1.7 and 6.7 per cent." As the major portion of the world's output of cast iron is of the grey variety, that is an alloy containing more than half as much silicon as it does carbon, together with considerable percentages of phosphorus, manganese and sulphur, how can one either practically, technically or academically regard it as "an iron-carbon alloy"? We dislike long definitions, but feel that it is essential, in this case, to give anything approaching a true picture of cast iron. We prefer a definition on these lines: Ordinary cast iron is a complex alloy containing, *inter alia*, between 1.7 and 6.7 per cent. of carbon, together with amounts, varying in importance, of silicon, manganese, sulphur and phosphorus. It may be objected that after all a chemically pure white iron is cast iron. We suggest, however, that from its very nature it is not "ordinary cast iron."

We have previously suggested that where exactness in reference to cast iron is desirable, the use of the words pearlitic, super-saturated and under-saturated, together with a short descriptive qualification, is desirable. Thus one could describe a very ordinary grey cast iron as a 3 per cent. silicon, high phosphorus, unsaturated iron. We feel that in time such phraseology must replace the use of such undesirable expressions as "common grey," "hard cylinder," "heavy machinery," and the like.

On the Definitions of Steel and Cast Iron.*

By Kôtarô Honda.

As to the question, what is steel? there has long been much controversy; even at the present day the question is not yet quite decided. The definitions of steel as given by several authorities may be divided into two classes—(i) Those based on the principal properties of steel and the method of production, and (ii) those based on the constituent of steel, that is, on the carbon content.

For example, steel is defined as an iron alloy, which can be hardened by quenching, or which results from melting and is very tough; or it is an iron alloy containing a certain quantity of carbon, which is tough and when quenched, hard and elastic, etc. A definition, however, based on the method of production is not appropriate; for when a new method has been discovered, the definition will have to be altered; and a material having the same constituents and properties as a steel cannot be called a steel, so long as its method of production is unknown. Again, the definition based on the properties of steel is also inadequate; for the words "hard", "tough" and "elastic" are all relative, and therefore we cannot determine the intensity of those properties, above or below which

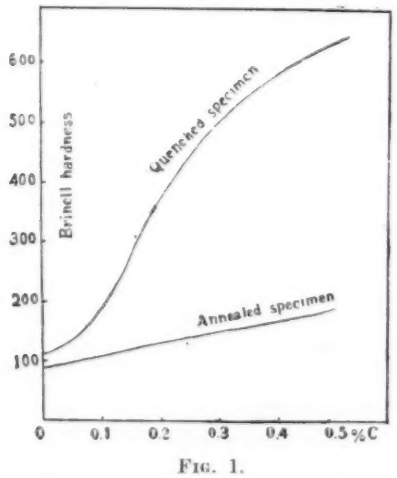


Fig. 1.

a material can be called a steel. Take for an example the hardness of a quenched steel; Fig. 1 shows the relation of the hardness of steels quenched and annealed to the carbon concentration in low carbon steels. The quenching temperature is for these steels above the A_3 point, and the quenching medium is water. From the figure, we observe that even in low carbon steels, a considerable hardening results from quenching, and that in steel containing only 0.1 per cent. of carbon, Brinell hardness is increased by 90, and even a 0.05 per cent. carbon steel by 30 as the result of quenching. In short, the hardness of a quenched steel decreases continuously with the diminishing content of carbon, there being no limit below which the hardness does not increase at all by quenching. Hence it is very difficult to define steel by reference to this important property of hardening. Similarly the definitions based on other properties of steel fail to distinguish steel from iron. Thus the editor of "Chemical and Metallurgical Engineering" gives up the first class of definition and adopts the second; thus, he defines steel as follows:—Steel is a malleable alloy of iron and its carbide.

But even in this definition, a property "malleable" is included and this definition is not therefore quite free from elements included in the first class of definitions. But according to the writer, we may equally well define "steel" by using the phrase "an alloy containing a small quantity of carbon" instead of the phrase "malleable alloy," since such an alloy usually possesses malleability. In this way, steel is defined completely by referring to its composition.

The next question relates to the quantity of carbon to be present in a steel. As to the lower limit of carbon, some metallurgists estimate it at 0.2 or 0.25 per cent., but this estimation is quite conventional and has no scientific meaning. It is a well established fact that at room temperature, iron dissolves carbon up to 0.035 per cent., and hence a quantity of carbon less than this amount is always present as a solid solution. According to the X-ray analysis, the solid solution of carbon in α-iron is martensite, and hence iron dissolving 0.035 per cent. of carbon is martensite containing a very small amount of carbon, in the strict sense of the words. This carbon always remains dissolved. It has therefore no relation to the A_1 transformation of steel, and is not in the least affected by quenching. Hence it is quite reasonable to place the lower limit of carbon at 0.035 per cent. Mr. H. Scott,* of the Bureau of Standards, Washington, also expresses the same opinion.

As to the upper limit of carbon in steel, the present writer places it at 1.7 per cent., which is the maximum solubility of carbon in iron at high temperatures. From the equilibrium diagram of the iron-carbon system, Fig. 2, it is observed that the alloys containing less than 1.7 per cent. of carbon have all a structure similar to that of ordi-

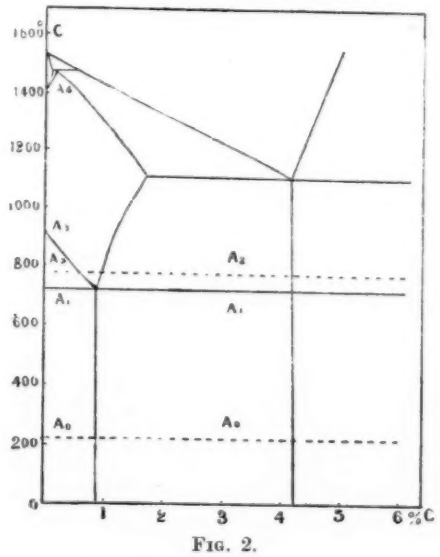


Fig. 2.

nary steels, and hence are included in the term steel. The definition of steel may then be defined as follows:—

"Steel is an iron-carbon alloy with a content of carbon lying between 0.035 and 1.7 per cent."

In this definition, wrought iron may be a steel lowest in carbon content.

Definition of Cast Iron.

The usual definition is also based on its method of production and its properties. For example, we have a definition for cast iron that it is "the direct product of the blast furnace or cupola, fusible and brittle," or "an iron alloy containing so much carbon that it is not malleable at any temperature." These definitions contain three elements, that is, the method of production, the property, and the composition. It is not, however, appropriate to include the method of production in the definition of cast iron, for the same reason as in the case of steel. The properties "fusible and brittle" have only a meaning in a relative sense, and therefore cannot be used in the scale of distinction. Again, to place the lower limit of carbon at 2.5 per cent., as is often the case, is arbitrary, as this figure has no scientific meaning. According to the equilibrium diagram of the iron-carbon system, Fig. 2, the alloys containing more than 1.7 per cent. of carbon have all a structure similar to that of ordinary cast iron; hence it is most natural to place the lower limit of carbon in cast iron at 1.7 per cent. The alloys having concentrations in the vicinity of 2 per cent. of carbon are sometimes called "semi-steels"; but from the structural point of view, they should be called

* From the Science Reports of the Tôhoku Imperial University.

* Chem. & Metallurg. Eng.

"semi-cast-iron". Of course, this terminology is quite conventional and has no scientific meaning.

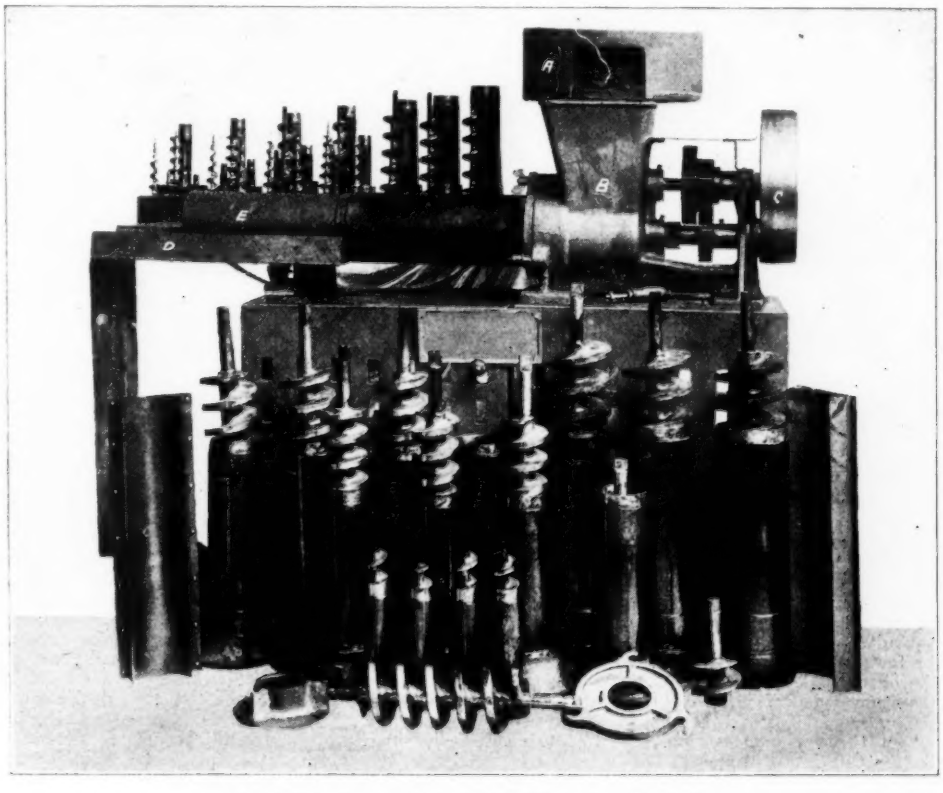
As to the upper limit of carbon in cast iron, there is no need to place it at 4.5 per cent.: but practically it is very difficult to introduce more carbon into the alloy than this amount, and hence the upper limit is naturally limited. But from the structural point of view, the upper limit should be placed at 6.7 per cent. of carbon, that is, at the concentration of cementite. Thus cast iron may be scientifically defined as follows:—

"Cast iron is an iron-carbon alloy with the content of carbon lying between 1.7 and 6.7 per cent."

A Power-driven Core-making Machine.

From the small beginnings of something strongly resembling a domestic sausage-making machine, the rotary core-maker has developed until now power-operated machines are available which give a range of diameters up to 7 in. The one illustrated below has been designed and put upon the market by Messrs. Geo. Green & Company, of Keighley, Yorks. In addition to possessing a range from 3/8ths in. to 7 in., in cylindrical cores, it is also capable of making special shapes, such as squares, hexagons, ovals and flats, whilst in every case the cores are vented automatically throughout their length. For operation, the prepared core sand is placed in box A, which feeds hopper B, of the machine proper. For making cores of smaller diameters—that is, varying from $\frac{3}{8}$ to 3 in. dia.—the driving pulley (C) is fitted with a suitable handle for operating by hand, but above that range mechanical power is used. Having chosen the correct sized die and conveyor, together with its corresponding tray (D), which latter is provided with a simple form of adjustable rest, the machine is set in motion. The feeding of the sand is regulated by the operator according to his judgment. Cores up to 24 in. in length can be rapidly produced. With the core oil recommended by the manufacturers a ratio of 18 parts of sea sand to 1 of oil has been found to be satisfactory.

The machine is fitted with a two-speed gear, the top speed being used when making small-sized cores by hand power and the low speed when making cores of from 5 to 7 in. dia. The gearing is machine-cut throughout and suitably protected by a guard plate, which has been omitted from our illustration in order better to show the construction.



A POWER-DRIVEN ROTARY CORE-MAKING MACHINE.

The Efficiency of Converter Plants.—Dr. E. Herzog, of Hamborn-Bruckhausen, contributes an article to "Stahl und Eisen" (July 9, 1925, pp. 1122-1125) on "The Efficiency of Converter Plants," in which the relations between the number of charges per hour and the converter requirements are reduced to mathematical form in dependence upon the most important working factors.

The Shrinkage of Malleable Iron.—In an article on "The Shrinkage of Malleable Iron" ("Stahl und Eisen," July 9, 1925, pp. 1189-1195) Dr. Emil Schütz, of Leipzig-Grosszschocher, describes the results of tests on open-hearth malleable iron. In hard castings it was found that white heart castings shrank on an average 1.93 per cent., the figure for thin-walled castings being rather higher and for thick-walled rather lower (with 7 and 15 mm. walls, 2.02 and 1.85 per cent.). The average shrinkage with black heart castings was 1.89 per cent., thin-walled castings showing somewhat higher and thick-walled somewhat lower shrinkages (with 7 and 15 mm. walls, 1.98 and 1.80 per cent.). White heart hard castings shrank rather more than black heart, when (as in this case) the carbon content was higher than in the latter. The difference in shrinkage was too small to be of practical importance. In annealed castings thin-walled white heart material was found to shrink to by far the greatest extent, viz., an average of 2 per cent. Thick-walled white heart castings and thin-walled black heart castings showed approximately the same skrinkage, viz., an average of 1 per cent. The shrinkage was less in inverse ratio to the temper carbon content in the metal, and greater in proportion to the decarburisation. It can therefore be influenced artificially by high or low tempering according to the wall thickness of the casting.

Association of German Iron Foundries.

FOUNDRY EXHIBITION IN DÜSSELDORF.

The Association of German Iron Foundries will hold its fourth Technical Exhibition from August 23 to September 11 this year in the Brüderstrasse Halls, Düsseldorf. The idea of the Exhibition is to show the possibility of giving a scientific stimulus to the entire field of foundry work.

Exhibits by individual firms are grouped about the scientific section of the Exhibition, and occupy the same amount of space. The area of the two sections is about 4,000 square metres. In regard to the exhibits by firms, stress has also been laid on actual novelties being shown as far as possible, so that this section of the Exhibition is worthy of the other. So far as foundry machinery is concerned, innovations will be shown in operation.

Model Foundry.

A complete foundry at work is specially worthy of notice, not merely because iron is there melted and cast into actual objects of use, but also because in this exhibition foundry the continuous system of work can be seen. An effort is here made to adapt to German conditions the continuous system which in America can be more easily employed in the mass production customary there. The copes and drags produced on several moulding machines are built up on a conveyor belt and then brought to the cupola furnace, where the moulds are cast. After a suitable cooling period the flasks are emptied and carried back to the moulding machines on a second conveyor belt.

About two hours a day will be devoted to melting. The foundry work has been undertaken by the Franz Schwarz Iron Foundry, Düsseldorf. The one-ton cupola furnace is furnished by Messrs. A. Hammelrath, Ltd., of Cologne. The furnace work will be carried out on a really scientific basis. For this purpose the cupola is equipped with all the requisite measuring instruments, *e.g.*, for ascertaining the temperature of the iron, slag and flue gases, and the capacity, velocity and pressure of the blast at different points. All the measuring instruments are by Messrs. Siemens & Halske, Berlin. The blower and accessory apparatus are provided by Messrs. Kühnle, Kopp & Kausch, of Frankenthal. The firm of Gust Zimmermann, of Düsseldorf-Rath have supplied the moulding machines. The apparatus for the continuous system of building-up was designed and supplied by Messrs. Carl Schenck, Limited, of Darmstadt.

The foundry products will be continuously tested in the chemical laboratory fitted up in the scientific section by Prof. Dr. Aulich, of Duisburg; similarly, special cast test bars will be currently tested in the cast-iron testing department, conducted by Geheimrat Rudeloff, Berlin.

The scientific section is arranged in five main groups, which comprise the whole technical field of foundry work. These are: (1) Preliminaries of foundry work, organisation; (2) general planning of foundries; (3) designing work; (4) the metallurgy of foundry work; and (5) testing and heat-treating of cast iron.

The exhibit of the "Datsch" (German Committee for Technical Education) in the department for technical foundry training, is specially worthy of mention. Here are shown striking advances in qualification tests, courses for moulders and apprentice pattern makers, "right and wrong" tables for pattern makers, core makers, and moulders, etc., etc. The exhibits devoted to the design of castings and pattern making endeavours to show scientifically the transference of technical ideas to the drawing and from the drawing to the mould. A department is also devoted to the scientific organisation of work in the foundry—a branch of study not yet much developed. The planning of foundries is exhaustively treated. The question of transport in the foundry—to which the greatest attention must be devoted—is illustrated with the greatest detail. Systematic studies of the wages paid for transport show that these sometimes amount to 50 per cent. of the cost of the casting produced.

In the moulding sand exhibit the very latest results of research, which are of great importance, are shown; the latest test processes are demonstrated in practice. In the moulding section the endeavour to represent the process of jog ramming by graphic lines of force is specially worthy of notice. The department devoted to drying the moulds shows, together with numerous up-to-date drying devices, the results of theoretical investigations in connection with drying ovens.

In regard to cupolas and other melting furnaces for foundry work, an effort is also made to advance the investigation of the internal processes, or at least to give a stimulus in that direction. A department dealing with the utilisation of waste material is also specially worthy of attention; its purpose is to promote this important but hitherto greatly neglected branch in foundry work.

In the last section special attention is directed to the results of the extensive experiments with regard to certainty in obtaining cast iron of high strength in foundry work, and in connection with the department dealing with the production of special castings a very well equipped collection of noteworthy castings of high quality is shown.

Dilatometric Investigation of Cast Iron.

In a note recently presented to the Académie des Sciences, by P. Chevenard and A. Portevin, the authors explained the use of the differential recording dilatometer for analysing the graphitisation of cementite, and following the variations in the condition of the carbon throughout the thermal cycle without recourse to other aids.

With regard to silicon, it is, of course, known to provoke and accelerate graphitisation in white cast irons, and a graph shows the result of heating three cast irons of increasing silicon contents from 600 up to 875 deg. C. In one case the Ac transformation on heating occurs right in the graphitisation period, and proves the independence of the two phenomena, the first being confined to equilibrium diagrams, while the second occurs irreversibly in a system not possessing equilibrium. The dilatometric investigation shows further that manganese and chromium cause continuous retrogression of the Curie cementite point, and that the carbides of both these metals form a solid solution with Fe_3C. Hence the name *bicarbides* should be replaced by *complex cementites*. On the other hand, the globular form preferably affected by certain complex cementites in special steels has nothing characteristic about it, being only the result of the influence of special components on the coalescence of cementite. Once more purely chemical investigation is proved to be misleading, while micrographical examination is not in a position to indicate the chemical nature and concentration of the components. But the physical investigation allows of following the variations in cementite-concentration by means of the position of the Curie point. By this method the authors were able to study the manner in which the distribution-coefficient of managnese varies between the carbide and ferrite according to the reheating temperature in a steel with 2 per cent. manganese. The Curie point of the carbide retrogresses when such temperature is increased. When to the influence of silicon are added those of manganese and special elements (nickel, chromium, etc.) the reheating problems become generally complicated, embracing a number stated in the text. Yet the dilatometric investigation permits of observing the order of succession and the manner in which one merges into the other, and of studying the effect of the various factors, such as chemical composition, temperature, structural condition, etc. The equilibrium lines of the stable diagram have known positions, except at temperatures bordering the eutectoid line of the non-stable system, hence we do not know the thermic divergence or aberration of the eutectoid lines in both systems. From dilatometric determinations, however, we are justified in assigning to this a value of some 30 deg.—Bulletin of the Cleveland Scientific and Technical Institute Abstract.

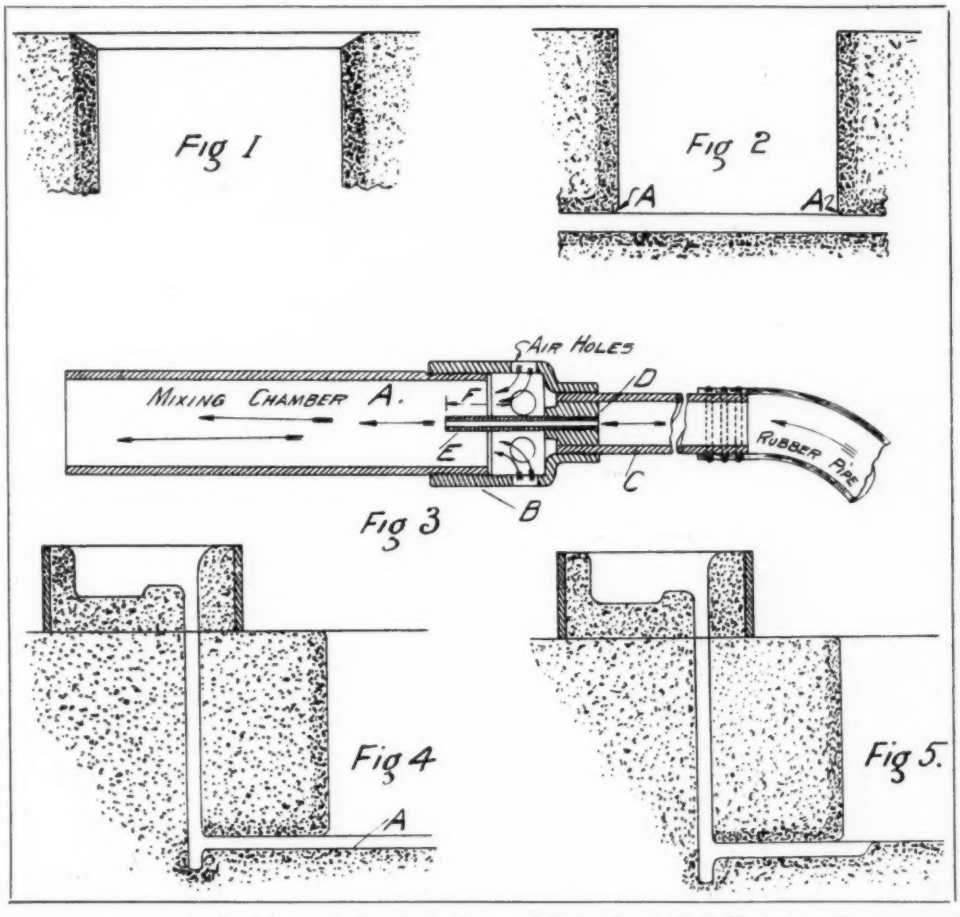
Skin-Dried Moulds.

By "Vallishe."

It was at one time thought that most large castings could only be made in dry-sand moulds. Since the introduction of skin drying, however, a vast amount of both light and heavy castings are made in green sand. For light castings a skin-dried mould will give the finished casting the colour and surface of dry sand ones. Many moulds have to be skin-dried on account of the sand containing too much clay, or, on the other hand, it may be of such a nature that it would not otherwise stand the heat and wash of the metal. The purpose of skin-drying need hardly be mentioned. It gives green-sand moulds a hard surface (as far as possible without moisture) similar to dry sand and loam moulds. The facing-sand used in skin-dried moulds should be of a loamy and very open nature, hardening only when heated, and yet sufficiently porous to allow the molten metal to lie against its face without bubbling or boiling. Sometimes the foundryman cannot obtain this particular class of sand for making facing. Ordinary sands mixed with core-gum, flour or thin clay wash form an efficient substitute. Flour should be used in the following proportion:—1 unit of flour to 25 to 30 units of sand, the latter depending, of course, on the nature of the sand used. Many moulders, however, seldom resort to the use of flour, on account of the extreme care which has to be taken in drying the mould. Too much heat is liable to burn the flour, resulting in the crumbling of the surface of the mould. If flour is omitted, the sand may be strengthened by aid of washes. The thickness of facing sand against the pattern varies from 1 to 2 in., common floor sand being sufficient for a backing. In the case of a deep-sided mould it is advisable to ram up ¾-in. rods with every other ramming. This also applies to moulds having heavy or deep copes. Skin-dried copes should be very closely gaggered, sprigs sometimes being used between the gaggers, the heads being level with the mould face, blacking being the only covering in this case. If this were not done, in all probability the skin on the mould surface would drop off. Some moulders take further precautions on this matter. The sides of drags are sprigged to eliminate the chance of the dried skin falling away from its green backing. Too much attention cannot be attached to the gates and all portions of the mould where the metal first enters. These should *always* be well sprigged, for once the surface of a skin-dried mould is broken the metal soon washes the entire skin away, the surface beneath then offering no resistance at all to the quickly flowing metal.

Finishing the Joint.

Many moulds are crushed through too much pressure on the joint, when the cope is closed. Great care should be taken in closing the mould, and it is always desirable to try the cope on the mould before finally closing it. A good method of preventing crushing is illustrated in Fig. 1. The joints at the top are shaved as shown, much danger then being eliminated. The utmost care should also be taken in holding the mould surrounding the gates, the safest plan being to make cores the shape of that part of the mould and ram them up with the pattern. Cutting at the gate should then be of no danger. This is without doubt the surest method of preventing such an occurrence. From the foregoing remarks it can be easily gathered that great delicacy in handling these moulds is demanded on account of the thinness of the skin, which will in most cases be broken by any jarring. There is no other type of mould that requires such delicate care in handling.



Finishing and Finishing Tools.

The general way of finishing skin-dried moulds is to wet the whole surface with either plain water

or a thin mixture of clay wash. A camel-hair brush is most suitable for this operation, and if applied lightly, good results are obtained. "Any old brush" is sometimes used for this job, but in the long run it does not pay. When the surface is moistened it is sleeked up in the same way as an ordinary green-sand mould. With large moulds, of course, the finishing and the moistening should be done in sections, unless, of course, "doubling-up" is employed. The question now arises as to the method of blacking the mould. There are several ways and means of doing this, but perhaps there are two outstanding methods. The first one is to rub the blacking on dry (in the dust form). Then sleek and moisten the surface well with clay wash applied with a soft brush specially kept for that purpose. The bottom of the mould need not be rubbed with blacking, a bag being used to shake it on. This method is most extensively used. Another method, however, is to black the mould in the same way as a dry-sand or loam mould. In some instances the two methods are used in conjunction with each other. When applicable, much advantage is gained by this, as when the mould is skin-dried with kettles or hot plates there are always parts of the mould which get more heat than the others. Judgment must be exercised in both damping the sand and blacking, or a uniform drying of the mould will not be obtained. This may cause burning, and perhaps, in extreme cases, a defective casting. As little sleeking as possible should be done, unless one is very skilful in this art, for if it is not done scabs will be formed, though there is no doubt that a smoother casting will be obtained if the sleeking is done carefully. If, however, the mould is smoothly blacked the casting will be quite smooth enough for the average standard of quality. The blacking should be used thin enough not to be streaked, a camel-hair brush being used for this purpose, the dangers caused by sleeking are then avoided.

Methods of Drying.

In drying skin-dried moulds sound judgment and care are again called for. Different types of moulds call for different methods of drying. Moulds such as those for anvil-blocks may be dried by means of a fire-kettle suspended in the mould. The cope is dried at the same time. Again some moulds call for a square fire instead of the round kettle, whilst others require plate-drying. Care should always be taken when starting the fire. A strong fire is apt to blister the mould, a mild but steady fire being much better. When applicable, a good method is to dry the mould when closed, the gates and risers being left open to let out steam. Some moulders use gas as a drier, the gas being conveyed by means of a rubber tube with a piece of iron tubing at the end. The flame can then be taken to any part of the moulds that require drying. This method of drying is perhaps more expensive, but it is much cleaner (no ashes having to be cleared away as in the case of a fire-kettle) and sometimes rather quicker. Fear of them blistering the mould is not so great as with an ordinary fire. Cores are generally dried in the stove, this being the most successful method. In Fig. 2 is shown a mould which requires special drying precautions. Obviously the sides will be dry long before the corners A. This type of a mould should be dried by either gas or hot air, so that each portion of the mould may be equally dried. Quite a large number of defective castings are the result of insufficient drying of remote corners in skin-dried moulds.

A Useful Gas Burner.

The objection in using an open-pipe burner for drying, is the great wastage of gas. Soot is also deposited on the face of the mould, causing loss of time and money. Fig. 3 shows a burner which has neither of these disadvantages, and is ideal for this class of work, besides being applicable for any other work requiring a gas-heater. The tube A should be $\frac{1}{2}$ in. in dia., having an overall length of 5 to 6 ins. This tube is screwed at one end, and is received by the main body B, which has $1\frac{5}{16}$ in. dia. holes drilled into it for air admittance. If required more holes may be drilled, though it is sometimes found that too much air is admitted. When this is the case, one or two of the holes may be stopped up by inserting wood-plugs. The tube C is screwed into the body B, and should be about 20 ins. long and $\frac{1}{4}$ in. dia. The plug D is driven into the body end of the tube C, thus closing it. A hole is drilled through the centre of the plug D and tapped to receive a $\frac{1}{16}$ in. dia. pipe E. A larger or smaller bore pipe should *not* be used, as the size given has proved to be the most economical and successful, the correct amount of gas being admitted to the body A. The distance F should be about $\frac{5}{16}$ in., but not less. A rubber tube is attached to the lower end of the tube C, and connected up to the main gas-pipe. The air and gas are mixed together in the tube A, this causing all the gas to be consumed, and a great saving in the amount of gas used compared with an open-pipe burner. The flame should be of a bluish tint, but non-luminous. If regulated properly great heat should be given out without any smell whatever. A burner of this type should be made for about 15s. to 20s., and is a tool that will pay for itself time and time again where much skin-drying is necessary.

Gating and Gating Troubles.

In gating skin-dried moulds, much trouble is caused by the friction set up between the inflowing metal and the sides of the mould. This causes numerous defects, the main defect being scabbing. If friction can hardly be avoided, the surface round the gates should be well sprigged, though cores for forming the gates are better. A gate as shown in Fig. 4 is an example of high-friction, and unless extreme care is taken, the casting will scab at the point marked A. In Fig. 5 is shown a gate which will overcome this difficulty. On entering the mould the metal will come up from the bottom, ensuring a steady flow. This form of gate can be applied to most moulds, and if used should eliminate scabbing, though it has one bad drawback, in that it does not deal with the dirt caused by the runner. It will be thus seen that moulds having cores or parts of the mould that are liable to catch dirt (especially in parts requiring sound metal) should not be gated in this manner. If the gate as shown in Fig. 4 is used, the dirt will be distributed to all parts of the castings in such a small amount as to form no scabs of any proportions, though there will, of course, be bad scabbing in front of the gate. In some casting this is not of great consequence, and can, in the circumstances, be endured. The best form of gating is that which will cause the minimum amount of friction between the face of the mould and the inflowing metal.

Costs and Other Considerations.

Whenever possible it is always advisable to "fight shy" of skin-dried moulds. They are not an economical proposition, and at the present time high costs must be fought against. Where drying is mostly accomplished by means of fires, great waste is encountered, besides in many instances literally filling the shop with smoke. Many large castings, of course, can only be successfully made in skin-dried moulds, but careful thought should always be exercised as to whether the casting cannot be made in an undried mould without unnecessary risk, for after all no moulder likes working on a skin-dried mould, and the human element plays the most important part.

B.S. Specification for Cast-Iron Filter Plates and Frames.—The British Engineering Standards Association have recently issued a Specification (No. 189-1925) for Cast-Iron Filter Plates and Frames, which was prepared as a result of proposals received by the Joint Committee of British Chemical Manufacturers and the British Chemical Plant Manufacturers' Association. Adherence to existing practice has been adopted as far as possible with a view to minimising the introduction of fresh cloth widths and enabling plates to be used in as many existing presses as possible. Particulars of installations comprising over 800 cast-iron presses were secured, and a suitable range of four sizes was chosen, which covered about 70 per cent. of the above presses, the selected sizes being in marked preponderance as compared with the very varied range of other sizes comprised in the list. Types of plates were then selected, which were felt to cover the majority of requirements. Copies of the Specification may be obtained from the B.E.S.A. Publication Dept., 28, Victoria Street, London, S.W.1. Price 1s. 2d. post free.

An Addendum to "The Practice and Purpose of Perlit Iron."

Mr. Young Replies to his Critics.

This Paper was presented at the Glasgow Conference of Institute of British Foundrymen. It was printed in our issue of June 11, and a report of the discussion upon it in the July 2 issue. In the following communication Mr. Young deals more fully with the criticisms raised. He writes:—

In further reply to Mr. Shaw. They had, in the foundries of the North-Eastern Marine Engineering Company, already made heavy castings in Perlit. Fig. 10 shows a Diesel compressor cylinder-liner which weighed nearly two tons. Fig. 11 is a Diesel cylinder-head weighing five tons. The latter is one of the most complicated castings which those foundries have to make, and contains something like twenty cores. Fig. 12 illustrates seven locomotive superheat headers; a smaller type of complicated casting weighing

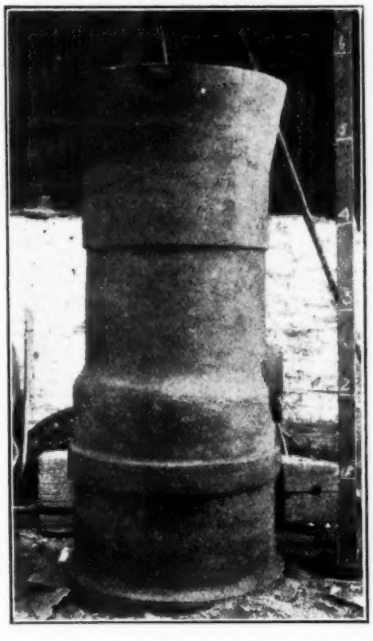


Fig. 10.—Diesel Compressor Cylinder-liner made in Perlit Iron. Weight nearly 2 tons. Casting Thickness varies from $1\frac{3}{4}$ in. to $2\frac{1}{8}$ in.

6 cwts.; and Fig. 13, Diesel fuel valves, weighing $2\frac{1}{4}$ cwts. The process appears to be applicable to any castings of any size or type, and can be worked in any ordinary modern foundry. The other day some visitors came to the works and were shown a large number of Perlit moulds being poured, which, considering the fact that two of those visitors were skilled foundrymen, and that we have been working the process for only a couple of months, proves the extreme error of those who say it cannot be done.

As experience is gained it will be possible to have smaller heads on the castings than those used in the ordinary way, and the author has seen cases where heads have been dispensed with altogether. Regarding reduction of scantlings, this naturally depends upon the design and type of work being referred to in any particular case. From 10 to 20 per cent. reduction will be possible in many instances; greater uniformity and superior resistance to fatigue and impact giving the metal a large advantage over non-Perlitised cast iron.

It was asked whether the mould should be hot in order to produce Perlit iron. In the author's opinion the process depends upon properly heated moulds associated with metal of the proper composition to suit the temperature of the mould. Do away with either of these things and "Perlitisation" is impossible. It is advisable to have the moulds as hot as convenient, in order to produce that "hesitation" effect to the greatest possible extent, and to extend the pearlite range so as to produce all-pearlitic structure in an iron of low-silicon content.

Anyone claiming to make Perlit iron by the ordinary cold-mould process cannot be conversant with the nature of Perlit. The very properties of the materials produced by this process depend upon the effects of the peculiar cooling conditions upon iron of particular compositions. In this connection the author is making some experiments upon the cooling-down of metal in a hot mould as compared with what happened in a cold one, also further experiments regarding the passage of heat through a sand-mould. These will be published in further papers.

A question was asked what variations were permissible in the composition of the metal. These are sufficiently wide to permit of easy control in

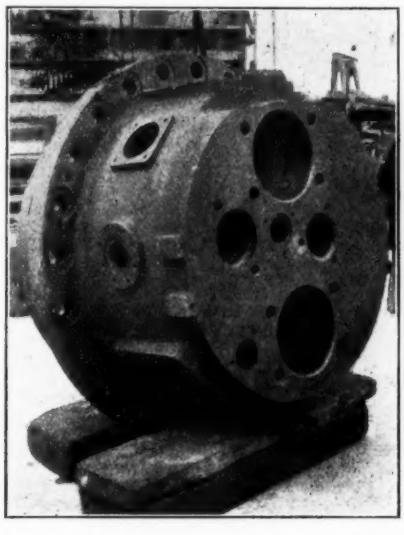


Fig. 11.—Diesel Cylinder Head made in Perlit Iron. Weight 5 tons. Casting Thickness varies from $1\frac{1}{4}$ in. to 4 in.

any foundry with a laboratory. Most of such foundries to-day have as much control as will be necessary. Of course, in dealing with extremely heavy castings the limits are not so wide, but that is in accordance with cold mould experience. As a matter of fact the process is applicable to all classes of foundry work and to all modern foundries.

With further reference to the high tensile American iron mentioned by Mr. Sharpe. If this iron comes under that class of metals which contains free graphite and combined carbon, then it would be improved by being perlitised. The author knows of no foundry work where the process would be of greater value than in the place where they are trying to make castings of very low carbon iron melted, say, in an open-hearth or electric furnace. There is a very definite field of operations in this sphere, and such foundries could go on to an even lower carbon or silicon content, or a higher chromium metal, and be able to get good castings and machinable iron.

The question of the description "Perlit" was raised by Mr. Primrose. The well-known word "pearlite," used almost exclusively by metallurgists, describes a particular structure found *more or less* in all commercial grey iron. It has never been established as a trade description of grey

iron castings, nor, to the author's mind, would it be a description of any significance. The word "Perlit" was coined to describe castings made under the conditions of this new process; in the works we talk about "Perlit" or "Perlit" iron; about "Perlitising" iron; about the "Perlit" process and so on; all of which convey, in a word, the meaning we desire to express.

Mr. J. E. Hurst's written contribution adds value to the discussion, and, although the author cannot accept Mr. Hurst's ideas as to what are the two fundamental features underlying this process, he welcomes his remarks. When iron is grey as cast, at a certain thickness, in a cold sand-mould, and is white when cast against a chill, we do not, because it is a familiar phenomenon, think it is particularly extraordinary. However, Mr. Hurst appears to find difficulty in realising that iron which is white or mottled, when cast in a cold sand-mould, will become grey when cast into a heated mould of similar dimensions. Our present knowledge proves that such must be the case. Cast iron, of any one composition, is more or less ferritic, or pearlitic or cementitic, according to the rate at which it is cooled through its critical points. In the case of the "Perlit" process we start with an iron which would be white or mottled or cementitic when cast into a cold sand-mould, and we heat that mould until an all-pearlitic structure is obtained. The greater the control the more nearly will the ideal be obtained.

That the condition of the graphite is modified is another feature which is to be expected from our present knowledge. That the initial "hesitation" gives a chance for a levelling-up of the temperature of the inner mould and cores and of the metal so that, to a great extent, all sections pass through the pearlite range at much the same speed and, therefore, finish up with much the same structure, is also reasonable. The author thinks that this is what actually happens, but as our knowledge extends so may our views alter. However, he has prepared specimens, and will send parts to Mr. Hurst and parts to the British Cast Iron Research Association. Also, at a later date, he will deal with this aspect of the process in a separate paper.

Really speaking, the two fundamental features of the process are that a lower-silicon iron than could be used in a cold mould is poured into a mould heated to that temperature which, the inventors have found, will produce an iron of pearlitic structure; the second feature being that this structure prevails throughout a complicated casting and is associated with a graphite structure better than usual. There are many other features of great interest, some of which apply to the elimination of foundry defects, others to the chemical composition and microstructure and others to the physical tests and behaviour of the metal in service. In view of the part Mr. Hurst has played in forming our past knowledge of cast iron, the author trusts that further knowledge and progress in our foundry industry will result from his interest in this new method.

When reading this Paper the author promised the members that he would publish no results other than those made and verified here in actual practice. In taking this attitude he was depriving himself of the use of much valuable work and data already published, and limiting his remarks to the meagre information obtainable in a few weeks previous to the publication of the meeting.

It is possible now, however, to give some further data. It has been the natural procedure to compare our "Perlit" castings with our ordinary ones. In order to do this we made "Perlit" castings from a standard pattern, split them open, and compared them with similar castings, made in the ordinary manner. The results were interesting by reason of the fact that the ordinary ones were more or less imperfect when submitted to this drastic test of being split open. For instance, "Perlit" globe valves are practically free from flaws and of similar grain throughout all sections, whereas ordinary ones vary in grain and have porous or "open" metal at vital parts; also they usually have internal flaws and defects. So it has proved to be throughout all types of castings;

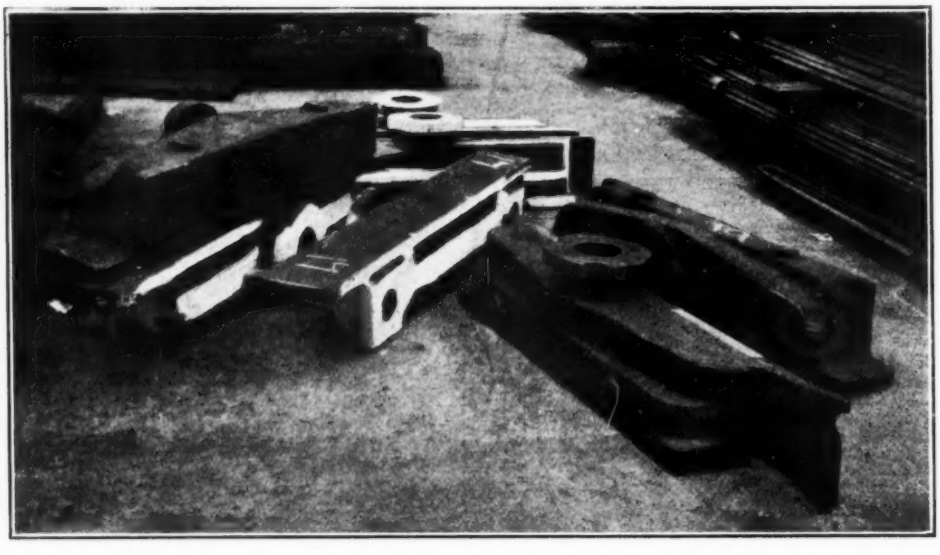


Fig. 12.—Seven Loco' Superheat Headers Made in Perlit Iron, each weighing 6 cwts. Casting Thickness varies from $\frac{5}{8}$ in. to $1\frac{1}{4}$ in.

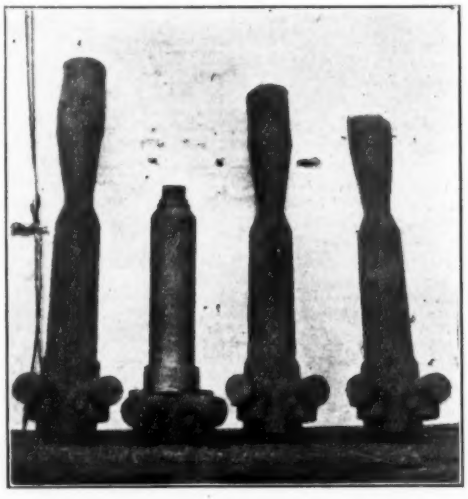


Fig. 13.—Diesel Fuel Valves, each weighing $2\frac{1}{4}$ cwts. Casting Thickness varies from $1\frac{1}{4}$ in. to $5\frac{1}{4}$ in. Made in Perlit.

those cast under "Perlit" conditions are superior, *as castings*, to ordinary ones. This getting of superior castings is a most important point, and means the reduction of "wasters" and a saving in costs. When abroad, the author was shown certain intricate castings—mass production—in which the percentage of "wasters" had been reduced from about 20 per cent. to almost nil, and this for no other reason than the adoption of the "Perlit" process. From what the author has seen now, he can quite believe the truth of this. In mass production the sheer perfection of the castings and the consequent cutting down of losses, in the foundry and the machine shops, more than justifies the new procedure.

Questions have been asked regarding strength. Here again the author's decision to give no other figures than his own has curtailed his remarks. Figures obtained in the course of every-day practice in the foundry from cupola-melted metal are to hand. In no respect are they experimental or "laboratory" results.

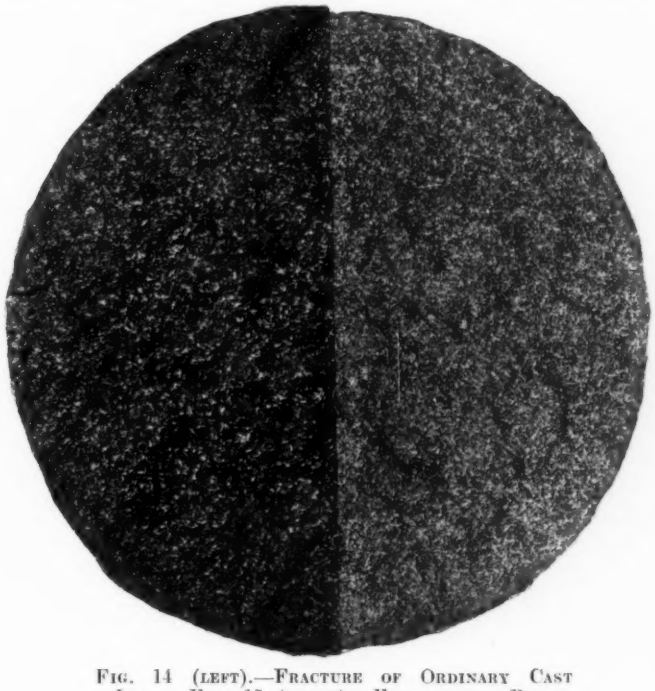


FIG. 14 (LEFT).—FRACTURE OF ORDINARY CAST IRON. FIG. 15 (RIGHT).—FRACTURE OF PERLIT IRON. BOTH WERE CAST 5¼ IN. THICK. (× ¾.)

Some test bars, cast 42-in. long and 5¼-in. diameter, were cast in ordinary cylinder iron and also in "Perlit." Wishing to demonstrate the remarkable resistance to impact of "Perlit" iron as compared with ordinary metal, we tried to break these bars by hitting them with a "johnny" two-handled hammer weighing 140 lbs. Two blows sufficed to break the ordinary iron; the "Perlit"

TABLE A.—*Tests Obtained from "Perlit" Iron.*

Casting.			Testbar.		Tensile Test.				Transverse Test.			
Description	Weight.	Variation in Section.	How Obtained.	Casting Thickness.	Diam.	Gauge Length.	Tensile.	Elongation.	Machined Size.	Distance between Supports.	Breaking Load.	Deflection.
	cwts			ins.	ins.	ins.	tons. sq. in.	Per cent.		ins.		ins.
Loco' Superheat Headers	6	⅜" to 1¼"	Cut from extended flange	1¼	0.798	2½	14.67 average of 11 castings	—	2 in. × 1 in.	36	35.4 cwt. (average) of 11 castings	—
	tons											
Diesel Main Liners	2¾	2⅞" to 4½"	Cut from block extended on flange	7½	0.798	2½	17.20	1.0	1 in. sq.	12	3,096 lbs.	0.177
Another (cast on different date)	,,	,,	,,	,,	,,	,,	17.02	1.0	,,	,,	4,168 lbs.	0.261
Various smaller castings.	—	—	Tapered bars, cast in separate moulds.	1¼	0.798	2½	20.24	1.0	Tested as cast	12	3,950 lbs. (flaws)	0.157
				,,	—	—	—	—	,,	,,	4,010 lbs.	0.143
				,,	—	—	—	—	,,	,,	4,049 lbs.	0.172
				,,	0.798	2½	19.04 (flaw)	1.0	,,	,,	4,090 lbs.	0.153
			Similar bar from same metal, but cast in cold mould.	,,	—	—	—	—	,,	,,	2,819 lbs.	0.069

(NOTE.—These last five bars had a diameter of 1 3/16 in. at the point of fracture.)

successfully resisted twenty-two blows, after which we broke it by dropping a 3-cwt. ball from a height of about 20 ft. It broke at the third blow. Among others witnessing this test was a chief superintendent of Lloyd's.

The fractures of these 5¼-in. bars are shown in Figs. 14 and 15, and demonstrate the difference between ordinary iron and "Perlit."

The table shows how our tensile and transverse are going.

From the above tests it will be appreciated that almost any quality of iron can be brought to conform with the requirements of the "Perlit" process. For those foundries specialising in cast irons of low carbon-content, no matter whether they be made by means of an electric or open-hearth furnace or by blowing air or gases through the cupola bed or receiver, or by adding low-carbon steel or iron to the ladle, the conditions of this process will lead to better castings and to higher-class metal. The same remarks apply to irons of the "alloy" class, for instance, those containing abnormal amounts of what are called impurities, namely, silicon or manganese, or those containing rarer elements, such as chromium or nickel.

It is recognised that immediately one leaves common cast iron and attempts to make castings of a better quality metal one walks into many foundry troubles. Probably this truth is the real explanation why so many foundries are unable, or unwilling, to produce a really superior iron. The "Perlit" process is, to the author's mind, the only practical solution of these difficulties which has been discovered. Special cast irons exist right and left, but a genuine and simple process of producing good and homogeneous castings from any quality of iron has not been available until now.

The running costs do not appear to be considerable, and the author hopes to present a Paper in the near future dealing with his experiences on this view of the matter. Almost any forced-draught core stove is capable of giving the required temperatures, whilst very economical furnaces are obtainable for heating floor-moulds.

In view of the fact that "Perlit" irons will compete for very many purposes with steel and with malleable iron, and also the improved foundry results as regards waster castings, there is little difficulty in seeing that foundries will adopt this new method with a view to actual reduction of costs and in order to increase their business.

In the foundries of the North-Eastern Marine Engineering Company, where the author is working, we are impressed so greatly by the results obtained in the foundry as well as in the machine and testing shops as to be looking forward to the time when all our more difficult castings will be made in "Perlit."

In this class of marine work hardly two castings are of the same dimensions, but in foundries dealing with repetition pieces the procedure could be organised so as to eliminate practically all wasters save those caused by actual bad moulding.

The author was told by a member at the Glasgow meeting that he did not like the process because the foundry would need to learn new ways. From the author's experience the main trouble with the ironfounding industry is that it is out of date and failing by reason of having had no "new ways" to learn. There is no reason why the future of cast iron should not be as great as has been its past, and everything points to the "Perlit" process being the first step in the right direction.

[When we first published Professor Bauer's article on "Perlit" cast iron, Mr. Young objected to a comparison being made between that material and "ordinary cylinder iron"—the latter being far too indefinite. As, presumably, "Perlit" iron would be mottled or white if cast normally, no real tests on "from the same ladle" basis can be made. However, we believe the publication of the tensile, transverse, chemical analysis, and, if possible, some impact test of the 5¼-in. round bar used for comparison could be given, then foundrymen would be in the position of knowing it was tested against high-class material.—EDITOR.]

MR. A. E. QUAIFE, Gwydir Chambers, 104, High Holborn, W.C.1, has been appointed liquidator of the Warwickshire Bridge and Engineering Company, Limited, 36, Parade, Leamington.

Properties of Unusual Alloy Steels.

BY C. H. S. T.

Some trials conducted for the Ordnance Department of the United States Government to determine the ballistic properties of light armour plate of unusual alloy steels has revealed some interesting mechanical properties of these metals. Alloys were prepared of carbon, silicon, nickel, aluminium, titanium, zirconium, cerium, boron, copper, cobalt, uranium, molybdenum, chromium and tungsten. The usual mechanical property and impact tests were carried out on all these steels, of which there were 193 heats.

In the first place, none of the steels presented any difficulties in rolling into plate except those containing boron. It was also shown that steel containing 0.40 to 0.50 per cent. carbon, 1.00 to 1.50 per cent. silicon, 3.00 to 3.25 per cent. nickel, and 0.60 to 0.80 manganese, and deoxidised with a simple deoxidiser such as aluminium, can be produced having a tensile strength of approximately 133 tons per sq. in., with excellent ductility and toughness. Though no details regarding the ballistic properties of such a steel have been made available, it is probable that such a steel could be successfully developed for structural purposes. Though the same high properties are obtained in steels of the above composition with the aid of additional elements, the results obtained do not justify the use of expensive alloying elements.

Zirconium, titanium and aluminium are found to act primarily as scavengers, and, when not removed, as part of the slag, these elements remain in the form of square inclusions not directly visible below a magnification of × 500. Such inclusions cannot be beneficial, and, when the steel is rolled, they appear as thin plate-like streaks.

Of the other elements regarded as special alloying additions, chromium, tungsten, vanadium and molybdenum go into solution and produce a martensitic pattern in air-cooled specimens. Cerium and uranium act in a similar manner, but they also show characteristic inclusions. Copper goes into solution, but a larger content is required to produce a martensitic pattern in air-cooled steels than for the other elements. Boron forms a complex eutectic, probably that of an iron-boron-carbon compound with iron, and this eutectic is fusible at the ordinary temperatures used in rolling, but at slightly lower temperatures, steel containing boron can be rolled successfully.

In some subsequent studies to determine the alloy recovery, the character and composition of the ingot and metallurgical behaviour in the furnace, a direct arc furnace was used.

These studies showed that even in very small ingots of 50 lb. to 100 lb., notable segregation of uranium, zirconium or cerium generally appears when over about ½ per cent. of the first, or about ⅓ per cent. of either of the last two is present in the steel. These readily oxidisable elements were best added in the ladle, or to the furnace immediately before pouring. In re-melting scrap containing these elements, they were almost wholly lost, even in electric furnace melting.

It was also found that uranium and especially zirconium alloys used to introduce these elements into steel, should be as free from carbon as possible. Alloys of zirconium with silicon or nickel, or both, give fair recoveries of zirconium, but no ferro-zirconium so far tried is successful in this respect. Titanium does not segregate as readily as zirconium, and its recovery from the ferro is higher.

THE DILATATION OF GREY IRON.—P. Oberhoffer and E. Piwowarsky, of Aix-la-Chapelle, contribute to "Stahl und Eisen" (July 9, 1925) a critical study on the mechanism of the dilatation of grey iron, accompanied by original curves, and state their attitude to existing theories.

COX & DANKS, LIMITED, of London, have now raised the sunken German destroyer "V.129," and beached it on the shore of Mill Bay, in the Orkneys. This makes the seventeenth vessel raised, at an average rate of one in fourteen days, creating a record in the salvage feats performed by this company.

Pattern Plates.*

By Adolf Haug, Dipl. Eng., Dessau.

In the foundry purely hand labour still plays a preponderating part in the manufacture of castings. As hand labour, however, is much more costly than machine work, efforts are constantly being made in the moulding shop to find means of replacing hand moulding by machine moulding as far as possible, and thus reduce the cost of production of castings to a minimum. This was primarily in connection with the quantity production of identical castings, for which hand moulding demanded too much time.

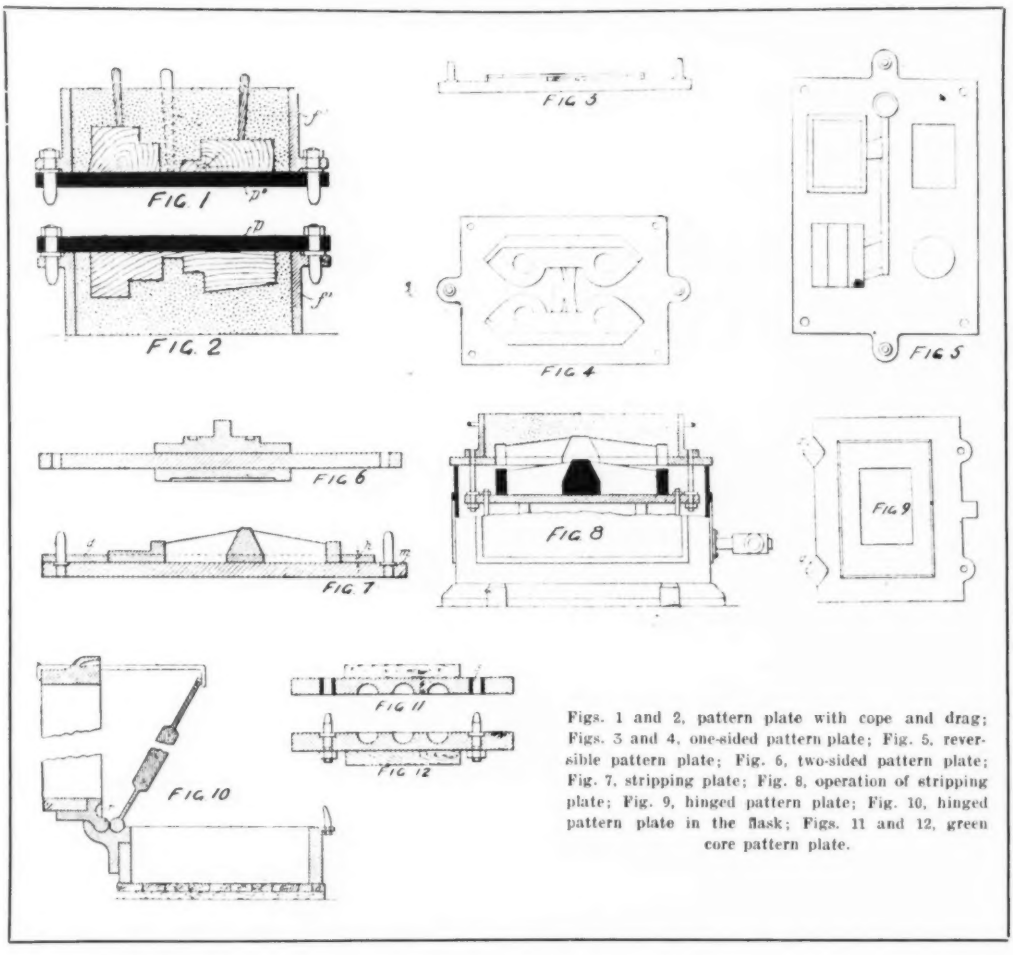
The means which gave the moulding shop the remedy required was the moulding board or pattern plate. As a further development of its use, the moulding machine was produced which for the first time rendered possible a really profitable method of operating this new moulding device. Pattern plate and moulding machine were developed and made more perfect, so that to-day they constitute an inseparable whole in the work. The moulding machine is still, however, merely the accompanying auxiliary of the pattern plate serving for its fuller application.

It would be instructive to show the whole development of this pattern plate and to collect all that has been written about it in separate contributions to technical literature. A comprehensive picture will here be given of the different types of pattern plates, their multifarious uses and their principal methods of construction. The moulding machine will be considered only in so far as is necessary for fuller comprehension. In moulding a pattern the lifting of the flask and the delivery of the pattern from the sand are the most difficult processes in the work. They demand of the moulder great care and skill, as if the mould is injured very tedious repair work is necessary. The weak point in connection with the lifting is that in permanent work the perfect fitting of the two box parts becomes inaccurate, while in delivering the pattern the danger is that the sand will be jerked loose. For these defects a remedy was sought in the pattern plate.

The pattern plate primarily originated from the fact that the patterns or separate patterns to be moulded were fixed to a smooth-planed iron or bronze plate. To make a mould two plates were necessary, one for the upper and one for the lower half. For the gates special pattern parts were introduced for simultaneous moulding. To ensure true lifting the upper plate p'' (Fig. 1) was provided with guide holes into which the bolts of the upper box part f'' fitted closely. The lower plate p was provided with bolts which fitted accurately into the corresponding holes of the lower box part f'. The arrangement must naturally be very accurate in order that no moulds showing eccentricity may be obtained. The moulding process in itself showed no new feature, except that pattern plate took the place of the separate pattern. Thus the following advantages are obtained:—

(1) By fixing the patterns on the pattern plate their position with regard to the available box space is fixed once and for all. It is unnecessary, therefore, to decide it anew every time. Only once, when the pattern plate is made, is it necessary to see that the distribution of the patterns is as advantageous as possible.

(2) No ramming board is required, as the



Figs. 1 and 2, pattern plate with cope and drag; Figs. 3 and 4, one-sided pattern plate; Fig. 5, reversible pattern plate; Fig. 6, two-sided pattern plate; Fig. 7, stripping plate; Fig. 8, operation of stripping plate; Fig. 9, hinged pattern plate; Fig. 10, hinged pattern plate in the flask; Figs. 11 and 12, green core pattern plate.

* Translated from "Stahl und Eisen."

pattern plate in itself forms a firm base for ramming the sand.

(3) The runners and risers for the entire casting are fixed on the pattern plate by means of special pattern parts at the same time as the patterns and moulded along with them. The work of cutting them out every time is thus saved. (Patterns of uniform section can, if desired, be arranged so that only a single continuous core is required.)

(4) It is possible to get all the pattern parts to deliver simultaneously from the mould with the utmost immunity from injury, owing to the accurate stripping facilities provided.

(5) As the patterns on the plate are subject to considerably less wear and tear (nowadays they are almost exclusively of iron or other metal), their life is practically unlimited compared with wood patterns; there is no loosening of glued parts.

(6) No pattern drawing tools are required.

The third and fourth points in particular present economic advantages. In place of skilled and expensive moulders, cheaper labour can be employed, whilst the few necessary manipulations of the moulding machine are quickly learned. Pattern plates are therefore used wherever possible with the utmost success in the rapid and accurate production of castings, and a considerable reduction in the costs of production is effected. The drawback of the pattern plate lies in its very costly manufacture, which makes it profitable only in quantity production, and further in its restriction of the castings to dimensions which are not too great.

Types of Pattern Plate and their Manipulation.

The original type of pattern plate has already been described. Even with this plate, notwithstanding the use of hand work, the withdrawal of the pattern from the sand was effected much more surely owing to better stripping.

The idea was therefore conceived of no longer effecting the delivery by hand, but of increasing the accuracy still further by mechanical means.

Apart from accurate delivery, which was the main cause of its development, the moulding machine also provided a remedy for another defect accompanying pattern drawing, namely, the suction effect of the sand with too-rapid drawing. This danger can be obviated by suitably constructing the raising and lowering apparatus of the machine. The withdrawal then takes place automatically, first with low and then with gradually increasing speed. At present there are about nine different types of pattern plate.

One-Sided Plates.

The one-sided pattern plate (Figs. 3 and 4) consists of two separate plates for the top cope and drag box parts, on which the corresponding pattern halves are fixed. The pattern plates are fixed, each separately, on the table of a moulding machine. The method of operation is either that of moving the rammed-up flask upwards with box pins by means of a lever gearing and lifting it from the table, or, conversely, that of lowering the table, together with the pattern plate, while the flask remains on adjustable projections.

Reversible Plates.

The reversible plate (Fig. 5) is for small patterns in one or two parts which it is desired to place on one plate, so as to have to use only one machine in making a complete mould. The pattern plate takes the moulds for the cope and drag boxes side by side, the central axis of the patterns lying symmetrically with that of the plate. The sand mould is made as before. From one combined mould, however, two complete castings are obtained.

Two-Sided Plates.

The two-sided pattern plate (Fig. 6) originated from the endeavour to make use of only one pattern plate in making a mould. At the same time, the cost of the second base plate is saved. In addition, the superposition of the half-pattern can be effected more accurately. With mechanical compression of the sand a complete mould is obtained with this plate in one operation. This plate is preferably used in the production of so-called "boxless" moulds, as in that case there is a saving in flasks and time.

Turnover Plates.

The turnover pattern plate is also fitted for single or two-sided work, but with the difference compared with these types that the moulding plate is arranged rotatably on the machine. In practice the lateral pivots of the plate are not fixed to the plate itself, but to the rotary table of the machine on which the two pattern plates are fixed. With the rotary plate the rammed-up bottom part is at first uppermost, and is then turned round 180 deg. and lowered on to a portable carriage placed beneath it. Or, conversely, the stripping is effected, after raising the rotary plate with the moulding box and turning them together 180 deg. by raising the pattern plate upwards. If both sides of the rotary plate are fitted with pattern plates the moulding of the cope can be completed immediately afterwards, as this automatically comes uppermost with the turning. In this way a complete box mould is obtained consecutively on one machine.

Stripping Plates.

The stripping plate is not really a pattern plate in the stricter sense, but rather an auxiliary plate for producing certain pattern moulds according to a pattern plate of the foregoing types. But as the latter in this case has certain modifications, it is customary to speak of the "stripping plate," meaning thereby the whole apparatus.

The method of operation is essentially as follows: The flask is not placed on the pattern plate, *m* (Fig. 7), but on a second plate, *d*, on which the pattern plate is seated and is adjusted by its bolts. This plate is superimposed in such a manner that, by means of holes in it corresponding exactly to the outlines of the pattern, the pattern projects into the half of the flask. Naturally the pattern must be higher by at least the thickness of the stripping plate. When the flask is ready, the entire set of patterns on the stripping plate moulding machine is drawn downwards through the plate with centreing pins, so that the stripping plate resting on the lower framework of the machine remains beneath the flask (Fig. 8), whereupon the latter is removed by hand. In cases where only certain specially projecting parts have to be pulled through, the arrangement must be such that the parts not requiring to be pulled through are fixed firmly on the stripping plate, the others, on the other hand, being pulled through the first from a second plate. The flask is then separated mechanically from the stationary plate upwards.

Stripping Combs.

The stripping comb is a simplified stripping plate. It is used as a substitute for patterns in which it is not necessary to have an exact outline for the support of the sand, but where merely an approximate outline is sufficient. The mode of operation is the same as before.

Mirror Plates.

The mirror pattern plate is in construction a one-side pattern plate for patterns which are symmetrical as regards the surface of their parts and their central axis. On their symmetrical application to the central line of the pattern plate the one half is "reflected" in the other. This pattern plate can be operated, according to the shape of the pattern, as a lifting plate, a turnover plate, or a stripping plate. To make a complete sand mould only one plate is required, which is moulded twice consecutively.

Hinged Pattern Plate.

The hinged plate has already been fully described.[1] It was perfected by I. Keep, manager of the Michigan Store Company, Detroit. It is largely used in American foundries. The pattern plate is essentially a two-side pattern plate (Fig. 9). It differs in construction, however, from the usual type by having on one of its sides two double-cone shaped dowels, *g*. These engage in correspondingly shaped bearings of the drag and cope (Fig. 10). The cope also has two solid double cones on its side;

[1] "Stahl und Eisen," 30 (1910), pp. 1558–62.

the drag is provided with the corresponding guides. In front of these is a second cavity, *r*, half in the cope and half in the drag, for the reception of the cones on the pattern plate.

Green Core Plates.

The green core pattern plate is intended for core patterns. The core mould must be fixed into the pattern plate. This pattern plate originated from efforts to find a remedy for the fragility of "green" cores. The plate enables the cores to be laid in with safety as they are inserted directly from the core box, and the moulder does not require to handle them at all. The plate consists of the "pin half" (Fig. 11) with the guide pins, and the "hole half" (Fig. 12) with the guide holes lined with a steel bush, *s*. The mode of operation has been fully described in a former article.[2]

Application of Pattern Plates.

The uses of the pattern plates described may be classified according to the following three main groups:—(1) Lifting pattern plates; (2) turnover pattern plates; and (3) stripping plates.

This classification is governed by the different height of the pattern walls. This height determines the method by which the pattern plates are best separated from the flask in order to obtain an undamaged mould.

The one- and two-side pattern plates belong to the lifting group. The separation is effected by raising the rammed half of the flask or by lowering the pattern plate out of it. In both cases the flask remains with the moulded side downwards, and in the case of the double plate at least the cope. With these moulds only patterns can be used with which there is no danger of portions of the sand being torn off in delivery. Only flat patterns with few exceptions are therefore suitable, which strip easily from the sand. A special application of the one-side pattern plate is in connection with the so-called "tier and stack castings," which were introduced by the Swabian Ironworks, in Wasseralfingen. The hinged pattern plate may also be included in this group. Its use likewise applies to flat, plate-like articles. The taper must be great enough to prevent the edges in the sand mould from being torn off on the side lying in the periphery of the folding circle when the plate is folded. The use of this plate saves much hand work with patterns (such as ornamental stove grate plates), which after the facing of the sand mould have again to be pressed into it. The plate has the disadvantage that the flasks require more careful handling, as the double-cone joint must not be injured and no sand must get into the bearings. The turnover plate also is comprised in this group.

In the case of patterns with high side walls or with highly complicated shapes it is necessary to have recourse to the turnover plate, as with the mere lifting a certain delivery is no longer obtained. If, on the other hand, the flask is turned 180 deg. before the delivery, then the sand mould always lies with the pattern side upwards, and any detached portions of sand can easily be pressed on again. The turnover plate is probably that most generally used, as it is suitable for nearly all ordinary moulds.

The stripping plate is used when it is required to mould very high patterns having sharp and high boundary lines, and particularly with vertical walls, for which even the turnover plate is no longer adequate for accurate delivery. In moulding, the stripping plate always remains beneath the flask until delivery has been completed. Owing to the edge of the stripping plate bearing closely against the outlines of the pattern, those portions of the sand inclined to tear off in the separation are supported by the plate and the sand faces are held firm. In exceptionally difficult cases recourse is had to a combination of the stripping plate and the turnover plate. The flask is then placed with the stripping plate on a turnover plate, and, after the sand is rammed, the whole is turned round 180 deg. The delivery is then effected in the usual manner by lowering or raising. The stripping comb serves the same purpose as the stripping plate. The so-called "mirror squeezing process" must also be mentioned. This is applicable with patterns in which it is necessary specially to support particular parts further from within. Here for the inner side a second stripping comb or a stripping plate is employed, which is simultaneously raised and supports the inner faces.

[2] "Stahl und Eisen," 38 (1918), pp. 360–1.

Construction of Pattern Plates.

Two main points are to be distinguished in the construction of the pattern plate:—(1) The material used in its construction, without regard to the type of pattern plate; and (2) the different processes employed in making the different types of pattern plates.

The material used may be wood, iron or some other metal, plaster of paris or some other similar substance. Nowadays, for making the pattern plate itself, wood is no longer used, but only for making the basis pattern from which the plate is constructed. For quantity production moulding it is, of course, subject to too great wear and tear.

Iron or some other metal is therefore selected for the pattern plate, so that it may have a long life. The most varied alloys are used, principally brass, bronze, aluminium alloys, white metal and also hard lead. The choice of the particular material is dependent on the purpose in view and the conformation of the pattern.

Iron (cast iron) will generally be selected for patterns which, while having relatively large dimensions, require thin walls combined with great strength, as in particular in the case of patterns for light builders' castings.

The metal alloys, on the other hand, are employed for smaller patterns or for completing larger iron patterns. These materials can be cast more easily and cheaply. The finishing is easier, and smooth, clean surfaces are obtained. Moreover, there is no danger of rusting. Aluminium is used when, for particular reasons, as light a pattern plate as possible is required. Notwithstanding the higher cost the plate of metal alloy is more profitable than the iron plate owing to its various advantages.

Plaster of paris is used partly as a fixing medium for wood and single-iron patterns, and partly for the pattern plate itself. Plaster patterns have the advantage of being made very quickly. The Bonvillain process is mainly based on plaster as the material for the pattern plates. Of late a composition of the nature of stone or cement has also been greatly used for pattern plates, which possess great durability and are cheaper to make than metal alloy plates.

Pattern plates made entirely of metal alloy are either solid plates or plates with screwed-on patterns. In the former class the base plate and patterns consist of a single casting. A process introduced by Fr. Dehne, of Halberstadt, for the manufacture of two-sided solid pattern plates, consists of moulding the two pattern halves in a two-part flask in sand, lifting them out and cutting out the gate channels. A wooden or iron frame is then inserted between the halves of the flask, of the thickness and external dimensions of the pattern plate to be made. The entire hollow mould is then cast, and the finished casting constitutes the solid pattern plate. The hinged pattern plate, which belongs to this type, consists of an aluminium-zinc alloy, the jointed parts being of malleable cast iron. Its manufacture has already been fully described elsewhere.[3]

The cast-iron plate with white metal covering may also be mentioned. This is used chiefly in America for stove grate parts and similar ornamental castings. It is intended to combine the strength of cast iron with the white metal's facility in working up. In addition, these plates do not rust. In the case of thin-walled flat castings requiring the dimensions to be most accurately adhered to, and in cases where it is necessary to deliver castings with the pattern plate which shall correspond with other castings moulded by hand, recourse is had to cutting up a sample casting into several pieces. The two last-mentioned processes have been already fully described on the basis of particulars derived from American sources.[4]

With screwed-on patterns the patterns and the base plates are made separately. The patterns

[3] "Stahl und Eisen," 30 (1910), pp. 1558–62.

[4] "Stahl und Eisen," 33 (1913), pp. 690–2.

are riveted or screwed firmly to the base plate. Wooden-base patterns must be given, in addition to a double contraction allowance, a second machining allowance for the metal pattern. Two-side plates are made by lightly soldering the finished metal pattern halves together and dowelling them through together perfectly perpendicularly at the points of connection. The one set of halves of the once more separated patterns is then arranged on the base plate and dowelled with the holes of the patterns as a gauge, the other halves being brought up so as to fit on the other side and fixed in common. To make the gate channels the plate is moulded in the sand and the channels are cut out of the separated sand moulds in the bottom flask, which is covered up again and cast. This pattern piece also is then fixed.

According to another method, the finished pattern halves are moulded in sand, and, after raising, placing the pattern base plates centred with the flask upon each half of the flask. The correct position of the pattern halves is determined by freeing them carefully from the sand so as to be able to mark the outlines on the plate with a marking tool. The patterns are then fixed to the plate, a cast being made to test whether the position is accurate.

Mirror plates are produced in a similar manner. The pattern halves, which have been dowelled together, are placed on the one-half of one side of the base plate, the dowellings being used as a gauge for the base plate. Beneath the base plate is now placed a "transfer plate" centred with it, and this is dowelled along with the base plate. The transfer plate is then turned over on the other half of the side of the base plate, which is not yet drilled, and the transfer plate is now used in its turn as a gauge from the centring for this side of the base plate. In this way the holes in which the respective pattern halves are to be fixed are obtained in the base plate precisely symmetrical with one another.

Plaster frames with embedded patterns should be employed when patterns already available are to be used. Here a cast-iron frame is taken, and the patterns, which are provided beneath with a fitting or hook, are firmly bedded in plaster. The patterns are first moulded in sand, and a frame of this description is placed over the raised parts of the flask and cast with plaster. Such plaster frames are suitable for a small number of castings in order to save frames.

Pattern plates entirely of plaster are made according to the special process of Bonvillain and Ronceray, of Paris, which is worked in Germany by the firm of G. Zimmermann, of Düsseldorf-Rath. It has already been dealt with in detail in a special paper.[5]

Stripping plates and green-core pattern plates must still be touched upon. These are smooth, planed-iron plates, in which the outlines of the patterns to be drawn through must be machined out most accurately. The centring holes or pins are placed on the short sides. Stripping combs are less expensive, as in their case the outlines do not require to be cut out so accurately. Relatively accurate but less expensive stripping plates are obtained if the interstices of a stripping comb and the pattern are cast with white metal. This method, however, is not so durable and accurate as a properly constructed stripping plate.

Green-core pattern plates, according to the article previously mentioned, are made either entirely by machining or, for more complicated cores, by casting.

British Non-Ferrous Metals Research Association.—This Association was incorporated on January 1, 1920, and has now completed the first five years of its existence, during which, like other research associations, it was guaranteed Government aid. After a somewhat halting start the Association, following the appointment as director of Dr. R. S. Hutton early in 1922, has achieved a striking success. Its income for the last year has been over £12,000, half being derived from subscriptions and the other half from Government funds. It maintains an extremely active and useful Information Bureau for the benefit of members, and has a large programme of investigations in hand.

[5] "Stahl und Eisen," 41 (1921), pp. 1726-31.

Iron Impurity in Cast Red Brass.

By C. H. S. T.

The presence of iron in brass is often regarded as an impurity, especially if it is found as badly alloyed grains, and for this reason a low ferrous content is usually specified for cast red brass. An easy, non-destructive method of ascertaining the presence of iron in brass would be of great value, and in this connection attention has been paid recently to magnetic methods of testing brass, which would be a valuable method of inspection if some definite relationship could be established between the iron content and the magnetic property.

Tests with the view of establishing some such relationship have been conducted, and it has been ascertained that the magnetic property of a cast brass is not a reliable index of the iron content of the cast metal. The tests were carried out on a series of alloys of the type 82 per cent. copper, 15 per cent. zinc, and 3 per cent. tin, with varying proportions of iron up to 0.75 per cent. The alloys were magnetised in a solenoid, a test coil was extended over two-thirds of the specimen, and readings of the magnetic induction were taken on a ballistic galvanometer.

The magnetic properties were determined in the cast metal, and after annealing for 15 minutes at 625 deg. C., 8 hours at 800 deg. C., and 16 hours at 800 deg. C. for different values of magnetising force. The microstructure of the metal was examined before and after the heat treatments, and it was seen that the cored structure of the cast metal largely disappeared after the first 8 hour annealing. The eutectoid present in the cast samples was also absorbed at the same time. The second 8 hour anneal caused no further change in structure. Up to 0.14 per cent. the iron went into solid solution in the matrix of the alloy, but larger amounts than this caused the appearance of pale, circular areas of an iron rich-constituent, and it was possible to form a rough estimate of the iron content from the size and number of these areas. The varying percentages of iron had no effect on the grain size of the metal, and the magnetic properties of the various specimens was unaffected by the grain size.

As mentioned, the magnetic properties of the various alloys was not a precise index of the iron content of the brass, though it was ascertained that the magnetic susceptibility was markedly affected by changes in physical conditions produced by heat treatment. After thorough annealing no direct relationship between magnetic property and iron content was established. The irregular magnetic behaviour of the alloys were probably due to the heterogeneous structure of the metal in the cast state, and by the occurrence of iron in two modifications, the dissolved and the segregated, in the annealed metal.

Charcoal as Cupola Fuel.

S. A. Damov, writing to a Russian technical journal, details some experiments he has made with charcoal as a substitute for coke in cupola practice. The lack of coke was the cause of the Oniejsky works utilising charcoal for the running of their cupolas. The average composition of this material was:—Fixed carbon, 95.56; ash, 0.92; and water, 2.52 per cent. The following returns were given:—Good castings, 70 to 72; scrap, 3 to 5; runners and risers and foundry losses, 12 to 15; melting loss, 9 to 10; consumption, 36 to 38 per cent.—all figures being in relation to the weight of iron charged. The cupola was 32 in. dia. and about 8 ft. 6 in. between the charging door and tuyere level. There were three 4-in. circular tuyeres delivering blast at 7.8 in. water gauge.

It was fan-driven at 1,700 r.p.m. It will thus be seen that charcoal is not economical from a technical point of view, but as a temporary measure it is possible to use it, providing the bed coke is reinforced by coke, anthracite or coal, which lowers the general consumption. It is advisable to use about 4 lbs. of coke to every 25 lbs. of charcoal, which will lower the charcoal consumption from 37 per cent. to 20 or 15 per cent.—"Revue de Metallurgie" Extract.

Ermack Spot-Welding Machine.

By the courtesy of Messrs. Ogilvy & Company, Mortimer Street, London, who are the selling agents, our representative recently had an opportunity of testing the Ermack welding machine illustrated. The spot-welding machine has long since established itself as a useful and reliable apparatus, whose field of operations is constantly extending, and during recent years little alteration has been made in the broad principles of design, though in refinement and detail considerable advances have been made.

Fig. 1.—Side View of Ermack Spot-Welder.

The machine illustrated is designed for single-phase alternating current, and can be made for any pressure between 100 and 500 volts. The machine is designed for a continuous output of 5 kva., 16 kva. maximum for intermittent work, and is capable of welding up to a maximum combined thickness of 13-16-in. iron sheets. Consumption of current at intermittent work is at the ratio of:— $= \frac{1}{5} \times \frac{\text{Welding time.}}{\text{Interval.}}$

The machine, it will be noted, is fitted to a heavy pedestal, the upper part of the machine being made of bronze fitted with a pair of elec-

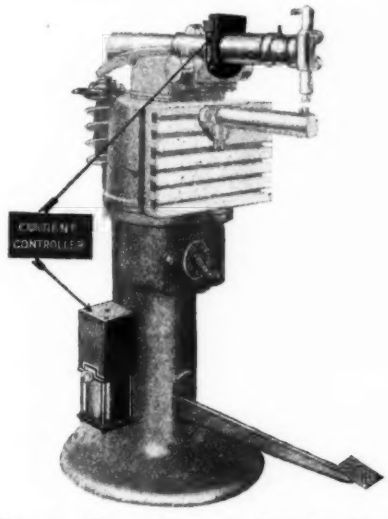


Fig. 2.—Front View of Ermack Spot-Welder, showing Current-Controller.

trode, non-adjustable brackets, the standard clearance for which is 400 mm. The transformer contained in the upper part of the machine is fitted with three tappings and plugs to adjust three stages of welding currents.

The whole of the parts are water-cooled; and up to this point the machine follows very much upon standard lines, its essential difference being in the embodiment in the construction of a very simple and automatic current controller, which is clearly shown in our illustration (Fig. 2). The controller is set to operate at a predetermined resistance, such resistance being of course related to the correct temperature necessary to make a perfect weld with the particular metal being dealt with; once so set it is impossible for the operator to make either a crystalline or, on the other hand, an unwelded joint.

It is merely necessary to press down the foot lever and hold it in that position, and so soon as the predetermined resistance is reached the controller makes connection to operate a solenoid and so cut off the current.

Instead of the fixed welding brackets the machine can be fitted with a baseplate for the horizontal and vertical adjustment of the brackets and a table can be fitted and provided with the necessary jigs or stops for expeditiously dealing with repetition work.

B.C.I.R.A. Members to Visit German Foundry Exhibition.

The British Cast Iron Research Association has sent a circular letter to its members, the chief points of which are extracted below:—

"The Fourth German Foundry Exhibition will take place in Düsseldorf from August 23 to September 11. From August 26 to August 29 the Association of German Ironfoundries holds its annual meeting in the same city.

"About 110 firms are exhibiting, including the largest foundries and engineering works, and the centre of the Exhibition is a special non-commercial section in five groups relating to science in the foundry, and there is also a model foundry lay-out.

"It has been suggested that members of the Association who desire to visit the Exhibition might prefer to go in one party, and it is therefore proposed that a group of members of the Association make a party to visit the Exhibition at the end of this month. The proposal is to leave London (Liverpool Street) on Friday evening, August 28, at 8.30 p.m., and travel via Harwich to Düsseldorf, arriving about noon on Saturday. The business meetings of the German Association will be over on the Friday, but the founders will remain in the city for the week-end, and members will have opportunities for meeting some of the German founders. The Exhibition will be visited on Monday and Tuesday, August 31 and September 1, and the return journey made on Tuesday about 5 p.m., arriving in London at 8.38 a.m. on Wednesday, via Harwich.

"The approximate inclusive cost from London for the period mentioned, including second-class travelling with saloon on the boat, is £12, and members will require passports duly *viséd* by a German Consul for visiting Germany.

"The report by the Director and Consultant on their recent visit to German foundries will be circulated before this proposed visit, and no difficulty is anticipated in arranging for members to stay on and see some German foundries if they desire to do so. A member of the staff of the Association who has some acquaintance with the language will be prepared to remain with the party.

"Members of the party will be relieved of all matters connected with travelling and hotel arrangements, and will be required to forward the cost involved to the undersigned not later than August 22, but further details will be sent to you in the event of your acceptance."

The letter is signed by Mr. J. G. Pearce, the Director. We are assured that about 15 members have decided to participate, and any of our readers who contemplate visiting this Exhibition would be well advised to communicate with Mr. Pearce at Central House, New Street, Birmingham.

Wm. Jacks & Company, Limited, have removed their London offices to Adelaide House, King William Street, E.C.4.

Trade Talk.

The United Steel Companies, Limited, have now restarted the blast furnaces at Moss Bay, Workington, which were damped down on August 1.

A large building at the Morrison Spelter Works, the property of the British Copper Manufacturers Corporation, Limited, caught fire last week, and was badly damaged.

The British Drying and Heating Company, Limited, 432, Abbey House, Victoria Street, S.W.1, have acquired from International Processes, Limited, the British patent rights to manufacture and supply the Oehm's patent heating element.

The Hull City Council has accepted the tender for British cables and supplies for the municipal telephone undertakings, and thus by a majority of one vote the Telephone Committee's decision to accept the slightly cheaper German tender was reversed.

Sir W. G. Armstrong, Whitworth & Company, Limited, have entered into a close working agreement with Breitfeld Danek, Limited, of Prague, Czecho-Slovakia, for their technical co-operation in the erection and installation of beet sugar factories in this country and throughout the British Empire.

The Cleveland Bridge & Engineering Company, Limited, and Edgar Allen & Company, Limited, have contracts for a new cement manufacturing factory at Dunstable, Bedfordshire. The Cleveland Company will prepare the site, foundations, railway sidings, roads, etc., and manufacture and erect the works buildings; Edgar Allen & Company will supply the cement-making plant.

Wm. Dobson & Company, Limited, of Walker-on-Tyne, have received an order from Pratt & Company, Newcastle, for the construction of a single-deck steamer to carry about 6,700 tons dead-weight on shallow draught. The engines will be built by the North Eastern Marine Engineering Company, Limited, and will have cylinders 25 in., 41 in., and 68 in. by 45 in. stroke.

Contracts Open.

Amiria, Egypt, November 2.—Supply and erection of a sewage pumping installation, consisting of four Diesel engines driving centrifugal pumps and auxiliary machinery, for the Ministry of Public Works, Egypt. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Ref. A.X. 2,278.)

Cairo, November 2.—Three large and one small Diesel engines with centrifugal pumps and auxiliary plant, for the Ministry of Public Works, Cairo. Inspecting Engineer, Egyptian Government, Queen Anne's Chambers, Westminster, London, S.W.1. (Fee £3 3s., non-returnable.)

Hong Kong, September 21.—Steel pipe main, for the Crown Agents for the Colonies. The Crown Agents for the Colonies, Z Department, 4, Millbank, Westminster, London, S.W.1. (Fee £5, returnable.)

Johannesburg, October 1.—Four four-ton electrically-driven portal jib cranes complete, for the South African Railways and Harbours. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Ref. A.X. 2,299.)

London, S.E.1, August 25.—Crane, for the Director-General, India Store Department Branch No. 14, Belvedere Road, Lambeth, S.E.1.

London, S.E., August 25-28.—Supply of wheels, etc., for the Director-General, India Store Department, Branch No. 14, Belvedere Road, Lambeth, S.E.1.

Melbourne, September 23.—Grinding machine, for the Victorian Government Railways. The Department of Overseas Trade. (Ref. A.X. 2,297.)

Poulton-le-Fylde, August 22.—Supply of 6-in., 4-in. and 3-in. cast-iron pipes and specials, for the U.D.C. Mr. J. H. Booth, engineer and manager, Gasworks, Poulton-le-Fylde.

Bulawayo, September 29.—Pump, etc., for the Municipality of Bulawayo. The Department of Overseas Trade (Room 48).

Warrington, August 29.—Pipes, for the Water Committee. Mr. J. Gray, waterworks engineer, Warrington.

Cast-Iron Test Bars.—Germany has adopted a test bar for cast-iron, 1.2 in. diameter and tested on 18-in. centres. This bar was also one of the standard bars suggested by the Institute of British Foundrymen, and has been approved by the American Foundrymen's Association. The Metals Committee of the American Society for Testing Materials has recommended the alteration of the standard American arbitration bar from 1.25 in. on 12-in. length to the above dimensions to ensure international agreement.

Obituary.

Mr. H. A. S. Biggin died at Hillside, Dore, on Tuesday. He was a director of the firm of George Tucker & Company, Limited, metal merchants' agents, of Norfolk Street, Sheffield.

Sir Robert Appleby Bartram, the well-known Sunderland shipbuilder, died on Saturday last at Harrogate. Sir Robert Bartram, who was in his ninety-first year, was a native of South Hylton, and lived there until 1878, when he removed to Sunderland, where his business interests had been all his life and of his predecessors. He was the senior partner in the firm of Bartram & Sons, shipbuilders, South Dock. His father, Mr. George Bartram, was a shipbuilder at Hylton, and began business in 1836. He died in 1899 at the age of 91. After completing his education, Sir Robert Bartram served his time with his father and acquired a thorough and practical knowledge of shipbuilding. In 1871 he entered into partnership with Mr. George Haswell, and for twenty years the firm continued under the style of Bartram & Haswell. At the end of that period Mr. Haswell retired, but prior to that Sir Robert Bartram had taken his two sons into partnership, and the name of the firm was altered to Bartram & Sons, which it now bears. He was at one time chairman of the Wear Shipbuilders' Association, and chairman of the Wear Workmen's Conciliation Board.

Patent Specifications Accepted.

Particulars of complete specifications accepted, furnished by Mr. Eric Potter, Patent Agent, of Lonsdale Chambers, 27, Chancery Lane, London, W.C.2. Printed copies of the specifications in the following list are now on sale.

237,303. Stewart & Son (Wolverhampton), Limited, J., and Jones, E. A. G. Sheet-metal hollow-ware. October 27, 1924.

237,306. Smith, S. C., and Chemical & Metallurgical Corporation, Limited. Treatment of ores or residues containing zinc. January 29, 1924.

237,308. Smith, S. C., and Chemical & Metallurgical Corporation, Limited. Treatment of lead chloride or basic chloride to convert it into other lead compounds and application thereof to the winning of lead from ores, residues, etc. January 30, 1924.

214,648. Levoz, T. Electric furnaces for melting and treating ores. April 17, 1923.

237,337. Imray, O. Y. (Bellis Heat Treating Company). Heat treatment of metals and metallic articles. April 22, 1924.

237,341. Rohrbach, A. Structural combinations of duralumin with other metals. April 23, 1924.

237,367. Ratcliff, F. G. Coiling mechanism for use more particularly with metal rolling mills. May 3, 1924.

237,413. Woodall Duckham (1920), Limited, Smith, E. W., and Finlayson, T. C. Manufacture of suspensions of iron compounds. June 24, 1924.

221,233. Debuigne, J. Aluminothermic processes of producing carbon free metals and alloys of low silicon content, etc.

222,145. Hirsch Kupfer Und Messingwerke Akt. Ges. Electric metal melting furnace. September 20, 1923.

On Sale on August 27, 1925.

210,758. Puening, F. Furnaces, etc. January 31, 1923.

237,779. Eckel, E. C. Process of making cement and iron. November 17, 1924.

Wills.

Brandon, H. L., formerly of Barrow-in-Furness, Lancs, iron-founder	£17,111
Fitzgerald, D. W., director of the Manchester Dry Docks Company, Limited	£96,140
Thomas, J. G., of Cheltenham, Glos., a director of the Gorse Galvanising Company, Limited	£4,073
Haswell, J., secretary of the Wear Engine Builders' Association and the Wear Shipbuilders' Association	£17,888

Messrs. W. P. Grosvenor and J. A. Clark, trading under the style of W. P. Grosvenor & Company, at 25, Victoria Street, London, S.W., engineers and merchants, have dissolved partnership.

Telegrams: "THROWER, GLASGOW." Telephone: 5909 CENTRAL.

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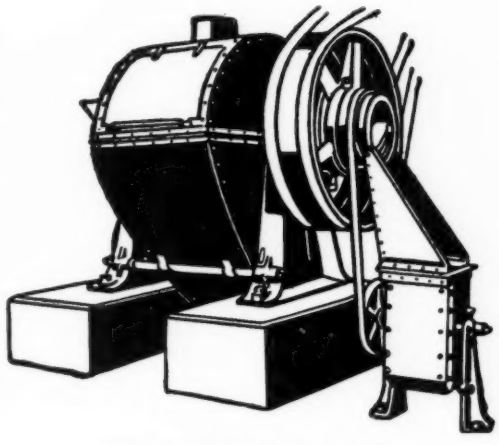
Head Office: 60, St. ENOCH SQUARE, GLASGOW.



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WITH MAGNETIC SEPARATOR.

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BRASS RECOVERY MACHINES

are the last word in the Treatment of Brass Foundry

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BELLOWS,
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CHAPLETS,
BRUSHES,
CORE ROPES.
BUCKETS,
SPADES, Etc.

Write for Illustrated Catalogue on Blacking and Foundry Requisites, also for our latest Price List.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—With buyers still confining purchases to almost retail proportions, business in the Cleveland iron market continues inactive as regards both home and export transactions, but with the promise of cheaper fuel in the near future with a consequent reduction of production costs the tone is distinctly more cheerful than has prevailed of late. At the moment, with French foundry iron offered at about 61s. per ton, f.o.b. Antwerp, there is an extremely limited European market for Cleveland iron and even in Scotland there is keen competition to be met, yet in spite of this wide margin there are still buyers who prefer Cleveland iron. Both to home and foreign consumers there is now a uniform quotation of 69s. 6d. per ton for No. 3 Cleveland G.M.B., but 73s. 6d. might be shaded for No. 1 foundry. There is not an abundance of the lower qualities, and makers ask 69s. for No. 4 foundry and 68s. 6d. per ton for No. 4 forge.

In the hematite market a somewhat better demand is current from home consumers, while prices have kept remarkably steady lately at 75s. 6d. for mixed numbers and 76s. for No. 1. On the North-West Coast, Bessemer mixed numbers still stand at £4 5s. per ton c.i.f. Welsh ports, £4 7s. 6d. per ton delivered at Glasgow, £4 10s. per ton delivered at Sheffield, and £4 15s. per ton delivered at Birmingham.

LANCASHIRE.—Many ironfounders in this district having bought more iron recently in anticipation of a probable shortage of raw material, have now sufficient stocks in hand to meet requirements over the current month, and consequently fresh business is difficult to obtain in the local markets. Notwithstanding the position, some makers of Derbyshire foundry iron are holding out for the old prices, viz., 77s. to 77s. 6d. per ton delivered in Manchester, but it is fairly certain that business could be done at 75s. 6d., and probably at something less. There is a little Northamptonshire iron offering, but the carriage is against the development of this trade in Manchester.

THE MIDLANDS.—An outstanding feature in the foundry pig trade in this area has been a general all-round reduction in prices at furnaces, although at the moment it is difficult to ascertain what effect this movement will have on local demand. Quotations now ruling are as follow:—Derbyshire No. 3 foundry, 67s. 6d.; Staffordshire No. 3 foundry, 70s. to 72s. 6d.; Northants No. 3 foundry, 62s. 6d. to 63s. 6d.

SCOTLAND.—The volume of business passing in foundry iron in this district continues on an extremely limited scale, orders being mainly confined to ten to twenty-ton parcels, for which keen competition is the rule. Prices are a shade easier again, No. 3 Scotch being offered at 81s. at furnace, with No. 3 Cleveland nominally quoted at 74s. 6d. per ton, f.o.t. Grangemouth.

Finished Iron.

South Staffordshire makers of crown and cheaper qualities of iron still have very great difficulty in getting orders, the chief reason being, of course, the exceptionally low prices being taken by the Continental houses, and to a lesser degree the fact that steel is now being used where formerly iron bars were required. Crown iron is quoted at £12 7s. 6d. per ton by the Associated firms, but 2s. 6d. per ton less than this is being taken by works outside the ring. Nut and bolt iron is quoted by the local mills at £11 7s. 6d., but, as indicated, little support is forthcoming, as although the Continental prices for iron stiffened during the last fortnight, it is still over £4 per ton cheaper than the local product. The marked-bar makers who have no such Continental competition to face are relatively in a much better position, but even they are not free from anxiety, and have only a few weeks' orders on the books.

Steel.

At Sheffield, the chief centre of the industry, business in all departments continues languid, very few fresh specifications for steel products being usually placed at this period of the year. Semis are in slack demand, especially basic qualities, but acid billets are in slightly more request, with some buying on a more extensive scale than of late. In the tinplate market, although the volume of business done has been anything but large, there has certainly been more buying all round of small parcels. Buyers are evidently of the opinion that prices are about the bottom, and that it is advisable to cover their actual early requirements, at all events. Very little forward buying is reported; 18s. 9d. seems to be about the ruling price, although many makers will not look at new business under 19s. to 19s. 3d.

Scrap.

The stagnation previously noted in the markets for scrap metal continues unabated, and it is at present extremely difficult to dispose of this class of material, even at the very low prices now quoted, which must by now have touched bottom levels. The following, however, represent the current quotations ruling at Tees-side:—Heavy steel scrap, 57s. 6d. per ton; heavy cast-iron machinery quality, 71s. to 71s. 6d.; ditto, ordinary quality, 68s. 6d.; heavy wrought piling iron, 72s. 6d.; bushelling scrap, 65s.; special heavy forge, 80s.; heavy steel turnings, 44s. to 45s.; cast-iron borings, 40s., all delivered works.

Metals.

Copper.—Business in most sections of the metal markets at this season is apt to slow down for the time being, and with demand slacker during the holiday month, buying is now restricted within modest dimensions. Notwithstanding this influence, favourable reports, regarding copper business in America, which are being received daily on this side of the Atlantic are imparting considerable strength to the market here, with the result that a fair demand is being maintained. When it is recollected that at the commencement of May standard copper was as low as £59 10s. and now is round £63, the progress that has been made in three months will be readily seen. Current quotations:—*Cash*: Thursday, £62 7s. 6d.; Friday, £62 10s.; Monday, £62 12s. 6d.; Tuesday, £62 15s.; Wednesday, £62 17s. 6d.

Three Months: Thursday, £63 7s. 6d.; Friday, £63 10s.; Monday, £63 12s. 6d.; Tuesday, £63 15s.; Wednesday, £63 17s. 6d.

Tin.—Movements in the standard market for tin have recently shown a temporary setback, but on the whole values remain fairly steady on the strength of the statistical position, without any ostensible reason for any substantial fall in the near future. The American market is also more active, while the Straits shipments for last month were about 6,000 tons, with deliveries to the U.S.A. fully equal to recent average. Current quotations:—*Cash*: Thursday, £256 5s.; Friday, £259 5s.; Monday, £257 5s.; Tuesday, £256 15s.; Wednesday, £256 17s. 6d.

Three Months: Thursday, £259; Friday, £261 15s.; Monday, £259 15s.; Tuesday, £259 5s.; Wednesday, £259 10s.

Spelter.—The market for zinc maintains a firm tone, and while consumers have not been buying very freely, business has improved, and there is now a tendency for galvanisers to purchase larger quantities. Although consumers have refrained from covering their requirements, producers, confident that this policy cannot be long maintained, have shown no readiness to sell. Current quotations:—*Ordinary*: Thursday, £36 6s. 3d.; Friday, £36 15s.; Monday, £36 17s. 6d.; Tuesday, £36 17s. 6d.; Wednesday, £36 16s. 3d.

Lead.—Exceptionally active conditions have been evidenced of late in this market, and lead consumers in the building industry have been once again up against high costs, from which there is not much hope of relief in sight, while the absorption of the metal on the part of the electrical branches continues on a very large scale. Since the end of July a significant feature has been the increased strength of forward metal on an extensive demand on Continental account, and the rise in the American price under considerably reduced stocks. Current quotations:—*Soft foreign (prompt)*: Thursday, £37 5s.; Friday, £37 17s. 6d.; Monday, £38; Tuesday, £38; Wednesday, £38 5s.

Stein & Atkinson, Limited, have recently received orders for Chapman agitators for fitting to existing gas producers at the works of Chance Bros., Limited, Smethwick; the Grovesend Company, Limited, Gorseinon; and W. Gilbertson & Company, Limited, Pontardawe, Glam. The same firm have also received an order from Jos. Crosfield & Sons, Warrington, for four Chapman gas producers in two batteries, with producer houses, coal-handling plant, gas tubing, etc., two silicate of soda melting furnaces, batch bins, batch mixer and modern tile chimney. They are also supplying to the same firm recuperative gas-fired settings for caustic soda pots. Other orders in hand include a case-hardening furnace for Platt Bros., Limited, Oldham, and two billet re-heating furnaces and gas producer for the Oil Well Engineering Company, Limited, Cheadle Heath.

FOR

SILACENE USERS ONLY

(ENGLAND, SCOTLAND AND WALES)

FREE TINS OF IRON CEMENT

WORTH A SHILLING A POUND

FROM THE DATE OF THIS ADVERTISEMENT TO DECEMBER 31st NEXT EVERY USER OF SILACENE WHO APPLIES FOR IT WHEN ORDERING WILL BE GIVEN A FREE SUPPLY OF OUR WELL-KNOWN "FEROCEM" CEMENT

AN ORDER FOR

10 TONS OF SILACENE

ENTITLES YOU TO

14 LBS. OF CEMENT FREE

WRITE FOR FULL DETAILS

THOMAS E. GRAY & CO., LTD.

The Makers of "SILACENE,"

119, HIGH HOLBORN, LONDON, W.C.1

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	62	17	6
Three months	63	17	6
Electrolytic	68	15	0
Tough	65	15	0
Best selected ..	66	5	0
Sheets	93	0	0
India	82	5	0
Wire bars ..	69	5	0
Do. Aug–Sept.	68	17	6
Do. Aug–Sept.	68	17	6
Ingot bars ..	68	17	6
H.C. wire rods	73	10	0
Off. av. cash, July	61	10	7 4/13
Do., 3 mnths. July	62	10	5 5/26
Do. Sttlmnt, July	61	10	6 15/13
Do., Electro, July	66	0	0
Do., B.S., July	64	0	10
Aver. spot price copper, July	61	10	6½
Do., wire bars, July	66	5	0
Solid drawn tubes			13½d.
Brazed tubes ..			13½d.
Wire			10d.

BRASS.

Solid drawn tubes	12d.
Brazed tubes ..	13½d.
Rods, drawn ..	10½d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g.	10¾d.
Wire	10½d.
Rolled metal ..	9¾d.
Yellow metal rods	7½d.
Do. 4 x 4 Squares	8d.
Do. 4 x 3 Sheets	8½d.

TIN.

	£	s.	d.
Standard cash	256	17	6
Three months ..	259	10	0
English ..	257	0	0
Bars	259	0	0
Straits	263	0	0
Australian ..	260	0	0
Eastern ..	264	10	0
Banca	263	5	0
Off. aver. cash, July	258	10	6 3/13
Do., 3 mths., July	260	17	6
Do., Sttlmnt., July	258	10	2 14/13
Aver. spot., July	258	10	2½

SPELTER.

	£	s.	d.
Ordinary ..	36	16	3
Remelted ..	36	12	6
Hard	30	10	0
Electro 99.9 ..	41	12	6
English ..	37	5	0
India	31	10	0
Zinc dust ..	42	0	0
Zinc ashes ..	14	10	0
Off. aver., July	34	14	0 2/13
Aver., spot, July	34	17	10½

LEAD.

	£	s.	d.
Soft foreign ppt.	38	5	0
English ..	39	10	0
Off. average, July	34	7	1 5/13
Average spot, July	34	13	11½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	42	0	0
Do. V.M. ex whf.	42	10	0
Dutch			—
Rods	48	0	0
Boiler plates ..	41	0	0
Battery plates	41	10	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	74	10	0
Chinese ..	65	0	0
Crude	53	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver ..	13	17	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro silicon 45/50% ..	£13 0 0
75%	£22 0 0
Ferro-vanadium— 35/40%	16/6 to 17/– lb. va
Ferro-molybdenum— 70/75% c. free	7/– lb.
Ferro-titanium— 23/25% carbonless	1/–lb.
Ferro-phosphorus, 20/25%,	£22 0 0
Ferro-tungsten— 80/85%, c.fr.	1/7½ to 1/8½ lb.
Tungsten metal powder— 98/99%	1/10½ to 1/11 lb.
Ferro-chrome— 4/6% car. ..	£23 10 0
6/8% car. ..	£23 0 0
8/10% car. ..	£22 10 0
Ferro-chrome— Max. 2% car.	£42 10 0
Max. 1% car.	£52 0 0
Max. 0.70% car.	£56 10 0
70%, carbonless	1/5 lb.
Nickel—99%, cubes or pellets	£170 to £175
Cobalt metal—98/99%	10/3 lb.
Aluminium 98/99%	£118
Metallic Chromium— 96/98% ..	3/9 lb.
Ferro-manganese (net)— 76/80%, loose	£15 10 0
76/80%, packed	£16 10 0
76/80%, export	£15 0 0
Metallic manganese— 94/96%, carbonless	2/–lb.

Per ton, unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten ..	2	6
Finished bars, 18% tungsten ..	3	0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. and over ..	4d. lb.
Rounds and squares under ½ in. to ¼ in.	3d. lb.
Do. under ¼ in. to ⅛ in.	1/– lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do. under ½ in. × ¼ in.	1/–lb.
Bevels of approved sizes and sections	6d. lb.
Bars cut to length	10% extra

Scrap from high-speed tool steel—

Scrap pieces ..	3d.
Turnings and swarf	1d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales— Hvy, steel	3	2	6 to	3	5	0
Bundled steel &shrngs.	3	0	0 to	3	3	6
Mixed iron & steel	3	0	0 to	3	2	6
Heavy cast iron	3	3	6 to	3	7	6
Good machinery for foundries	3	10	0 to	3	12	6
Cleveland— Heavy steel ..	2	17	6			
Steel turnings ..	2	4	6			
Cast-iron borings	2	0	0			
Heavy forge ..	4	0	0			
Bushelled scrap	3	5	0			
Cast-iron scrap	3	11	0 to	3	11	6
Lancashire— Cast-iron scrap ..	3	12	6			
Heavy wrought	3	12	6 to	3	15	0
Steel turnings ..	2	5	0			

London — Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean) ..	54	0	0
Brass (clean) ..	41	0	0
Lead (less usual draft)	33	0	0
Tea lead ..	29	0	0
Zinc	24	0	0
New aluminium cuttings ..	95	0	0
Braziery copper	49	0	0
Gunmetal ..	49	0	0
Hollow pewter ..	182	0	0
Shaped black pewter	132	0	0

PIG-IRON.

(f.o.t. unless otherwise stated).

N.E. Coast— Foundry No. 1 ..	73/6
Foundry No. 3 ..	69/6
Foundry No. 4 ..	69/–
Forge No. 4 ..	68/6
Hematite No. 1 ..	76/–
Hematite M/Nos. ..	75/6
N.W. Coast— Hem. M/Nos. d/d Glas.	87/6
,, d/d Birm. ..	95/–
Midlands— Staffs. common* ..	102/–
,, No. 4 forge ..	67/6
,, No. 3 foundry	71/3
Shrops. basic ..	75/–
,, Cold blast, ord.*	190/–
,, ,, roll iron*	195/–
* d/d Birmingham.	
Northants forge ..	57/6
,, fdry No. 3 ..	63/–
Derbyshire forge ..	62/6
,, fdry No. 3 ..	67/6
,, basic	72/6
Scotland— Foundry No. 1 ..	86/–
,, No. 3 ..	81/–
Hem. M/Nos. ..	82/6
Sheffield (d/d district)— Derby forge ..	66/6
,, fdry. No. 3 ..	71/6
Lincs. forge ..	68/–
,, fdry. No 3 ..	72/–
E.C. hematite ..	85/6
W.C. hematite ..	90/–
Lincs. (at furnaces)— Forge No. 4 ..	63/–
Foundry No. 3 ..	66/–
Basic	66/–
Lancashire (d/d eq. Man.)— Derby forge ..	70/6
,, fdry. No. 3 ..	75/–
Northants foundry No. 3 ..	76/–
Dalzell, No. 3 ..	111/6
Summerlee, No. 3 ..	98/6
Glengarnock, No. 3	98/6
Gartsherrie, No. 3 ..	98/6
Monkland, No. 3 ..	98/6
Coltness, No. 3 ..	98/6
Shotts, No. 3 ..	98/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	11	12	6 to	12	10	0
Angles		12	7		6	
Tees to 3 united ins		13	2		6	
Nut and bolt		11	15		0	
Hoops	14	0	0 to	15	0	0
Marked bars (Staffs.) f.o.t.		14	10		0	
Gas strip ..		13	0		0	
Bolts and nuts, ¾ in. × 4 in. ..		16	15		0	
Steel— Ship plates	8	10	0 to	9	0	0
Boiler plts.	£12	10	to 13	0	0	
Chequer plts.	£	9	15 to	10	5	0
Angles	£8	0	0 to	8	7	6
Tees	£9	0	0 to	9	7	6
Channels	£7	7	6 to	7	17	6
Joists	£8	0	0 to	8	7	6
Rounds and Squares 3in. to 5½in. ..		9	5		0	
Rounds under 3 in. to ¾ in... ..		9	0		0	
Flats, over 5 in. wide and up ..		9	15		0	
Flats, 5in. to 1½in.		8	15		0	
Rails, heavy ..		8	10		0	
Fishplates ..		12	10		0	
Hoops (Staffs.)	£11	0	0 to	11	10	0
Black sheets, 24g.	11	10	0			
Galv. cor. sheets, 24g.		16	0		0	
Galv. fencing wire 8g. plain ..		14	0		0	
Billets, soft	6	10	0 to	7	15	0
Billets, hard ..		9	0		0	
Sheet bars	6	12	6 to	6	15	0
Tin bars d/d	6	12	6 to	6	15	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g. ..	1	3½
Wire	1	3¾
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled— To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/– to 1/8½
Wire round— 3/0 to 10 G. ..	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	21.26
No. 2 foundry, Valley	20.26
No. 2 foundry, Birm.	18.00
Basic	19.76
Bessemer	20.76
Malleable	20.26
Grey forge	19.76
Ferro-mang. 80% d/d	115.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess. billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	35.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.17
Steel bars	2.00
Tank plates	1.90
Beams, etc.	2.00
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.40
Sheets, black, No. 28 ..	3.15
Sheets, galv., No. 28 ..	4.00
Sheets, blue an'l'd, 9 & 10	2.32
Wire nails	2.60
Plain wire	2.55
Barbed wire, galv. ..	3.30
Tinplate, 100 lb. box ..	$5.55

COKE (at ovens).

Welsh foundry ..	37/6
,, furnace	27/6
Durham & North. foundry ..	35/-
,, furnace ..	16/6
Other Districts, foundry	35/-
,, ,, furnace (Basis)	13/6

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes, 20 × 14, box		18/9
,,	28 × 20, ,,	37/6
,,	20 × 10, ,,	27/9
,,	18¾ × 14, ,,	19/9
C.W.	20 × 14, ,,	17/1½
,,	28 × 20, ,,	34/9
,,	20 × 10, ,,	24/–
,,	18¾ × 14, ,,	17/4½

Terneplates 28 × 20, 35/6 per box basis f.o.b.

SWEDISH IRON.

Bars, hammered	£19/0 to £20/0
Rolled Ord.	£16/0/0 to £16/10/0
Nail rods	16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£10 to £14
Pig-iron	£6 15 0 to £7 0 0

all f.o.b. Gothenburg.

TUBES.

Up to and incl. 6 in.

Gas .. 55% } Tube prices
Water .. 50% } are
Steam .. 45% } now free.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
Aug. 13	62	7	6	No change
,, 14	62	10	0	inc. 2/6
,, 17	62	12	6	,, 2/6
,, 18	62	15	0	,, 2/6
,, 19	62	17	6	,, 2/6

Electrolytic Copper.

	£	s.	d.	
Aug. 13	67	15	0	No change
,, 14	68	0	0	inc. 5/-
,, 17	68	10	0	,, 10/-
,, 18	68	15	0	,, 5/-
,, 19	68	15	0	No change

Standard Tin (cash).

	£	s.	d.	
Aug. 13	256	5	0	dec. 45/-
,, 14	259	5	0	inc. 60/-
,, 17	257	5	0	dec. 40/-
,, 18	256	15	0	,, 10/-
,, 19	256	17	6	inc. 2/6

Tin (English ingots).

	£	s.	d.	
Aug. 13	256	10	0	dec. 40/-
,, 14	259	10	0	inc. 60/-
,, 17	257	10	0	dec. 40/-
,, 18	257	0	0	,, 10/-
,, 19	257	0	0	No change

Zinc Sheets (English).

	£	s.	d.	
Aug. 13	42	0	0	No change
,, 14	42	0	0	,, ,,
,, 17	42	0	0	,, ,,
,, 18	42	0	0	,, ,,
,, 19	42	0	0	,, ,,

Spelter (ordinary).

	£	s.	d.	
Aug. 13	36	6	3	inc. 1/3
,, 14	36	15	0	,, 8/9
,, 17	36	17	6	,, 2/6
,, 18	36	17	6	No change
,, 19	36	16	3	dec. 1/3

Lead (English).

	£	s.	d.	
Aug. 13	38	5	0	No change
,, 14	38	15	0	inc. 10/-
,, 17	39	0	0	,, 5/-
,, 18	39	0	0	No change
,, 19	39	10	0	inc. 10/-

Exports of Iron Castings in July and the seven months, 1925, compared with July and the seven months, 1924.

	July, 1924.	July, 1925.	Seven months, 1924.	Seven months, 1925.	July, 1924.	July, 1925.	Seven months, 1924.	Seven months, 1925.
BUILDERS' CASTINGS—								
Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and Washing Boilers:—	Tons.	Tons.	Tons.	Tons.	£	£	£	£
To Argentine Republic	156	107	784	877	5,468	5,727	28,720	32,635
,, British South Africa	470	358	1,970	2,235	15,275	12,341	68,846	79,203
,, ,, East Indies	130	110	787	1,007	5,622	4,179	34,743	47,248
,, Australia	57	27	446	411	3,205	1,520	25,384	22,597
,, New Zealand	260	222	1,234	1,600	12,400	9,898	59,446	74,670
,, Other Countries	680	614	3,746	4,463	35,559	31,817	187,354	226,719
Total	1,753	1,438	8,967	10,593	77,529	65,482	404,493	483,072
PIPES AND FITTINGS—								
Cast—								
To Argentine Republic	1,416	1,120	4,516	6,996	19,578	13,492	61,896	89,294
,, British South Africa	473	369	5,207	4,523	8,147	5,751	65,301	62,925
,, ,, India	949	493	7,004	6,183	14,208	6,450	104,325	87,418
,, Straits Settlements & Malay Sts.	1,026	832	6,171	3,981	15,002	10,483	78,852	47,123
,, Ceylon	83	63	658	852	1,046	752	9,026	10,539
,, Australia	522	140	2,894	2,136	8,557	3,209	44,038	33,614
,, Other Countries	4,589	4,704	22,661	32,872	80,739	69,125	382,510	488,711
Total	9,058	7,721	49,111	57,543	147,277	109,262	745,948	819,624
HOLLOW-WARE—								
Cast not Enamelled, & Cast, Tinned	584	530	3,711	4,828	23,402	22,170	149,307	162,601
,, Enamelled	86	108	655	613	9,500	10,576	67,757	61,369
CASTINGS, in the rough—								
Iron	123	118	777	872	5,334	4,065	32,422	32,565
Steel	105	156	1,865	434	4,644	5,461	32,327	17,328

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SMALL ADVERTISEMENTS.

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Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 7 words per line. Minimum charge for one insertion 3/-.

SITUATIONS VACANT AND WANTED.

FOUNDRY FOREMAN, disengaged, desires position; experienced all branches of engineering and jobbing work, iron and non-ferrous, up-to-date on cupola and mixing of metals by analysis; McLain graduate; good organiser.—Box 424, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOUNDRYMAN or Handyman requires position as Cupola Tenter or Assistant (receiver or ordinary cupola), charger, liner, or ladle dauber; in Birmingham or near preferred; strong, willing, married, ex-Service; good references; age 26; eight years' mixed experience.—Box 418, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MR. W. H. MEADOWCROFT, M.I.Brit.F., of 72, Elliott Street, Tyldesley, near Manchester, having had extensive experience in the management of IRON FOUNDRIES, wishes to get in touch with OWNERS or FOUNDRY SUPPLY and EQUIPMENT MANUFACTURERS, who could utilise his extensive experience in the practical and technical control of large foundries to mutual advantage.

GREY IRON FOUNDRYMAN wants position as Foundry Manager or Foreman; sound technique in all branches; costing, estimating and commercial experience; salary moderate.—Box 402, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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MOULDER, skilled, energetic Foundryman, seeks situation; thoroughly experienced in best class work, and general country foundry practice; low wage for regular work, and hard work and brains given to make pay.—MOULDER, Westleigh, Micawber Avenue, Hillingdon, Middx.

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FOR SALE.—20-in. and 24-in. Hall's Invincible Sand Mixers; the original and best machine in the market for mixing old and new Foundry Sand, Coal Dust, etc.—Apply PENNEY & PORTER (ENG.), LTD., Lincoln.

SAND MIXERS.—New and secondhand. Ask us to quote.—W. BREALEY & COMPANY, LTD., Russell Street, Sheffield.

FOR SALE, Evans Magnetic Separator, 2 ft. 6 in. x 1 ft. 6 in., £5 5s.; Evans Sand Sifter, with two sieves, 3 ft. 3 in. x 2 ft., £3 18s.; Evans Water Rumbler, geared barrel, 3 ft. x 2 ft. dia., £15 10s.; Western Block, lift 10 tons, with two 12-ft. foot legs £4 18s.; Evans Moulding Machine, with two fittings and plates, £7 10s.—HODGSON, 12, Heath Street, Hampstead, N.W.3.

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MACHINERY.—*Continued.*

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Two Morgan 800 lbs. Crucible Tilting Furnaces (oil fired, could be converted), £25 each.

Ten Morris 1-ton Chain Lifting Blocks (spur wheel type), £6 each.

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One Morris 40-cwt. Travelling Lifting Block (worm gear), £9 10s.

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One Morris Overhead Travelling Crane, 41 ft. 5 in. span, 3-ton capacity, hand operated, £50.

One 2-ton Electric Overhead Travelling Crane, with motors, 35 ft. 9 in. span, £135.

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"PEERLESS" Core Sand Binder.—Please see our advertisement this Journal, August 6, page six, and try a sample; drum or cask.—WILLIAM OLSEN, LIMITED, Hull.

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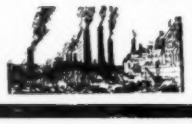

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